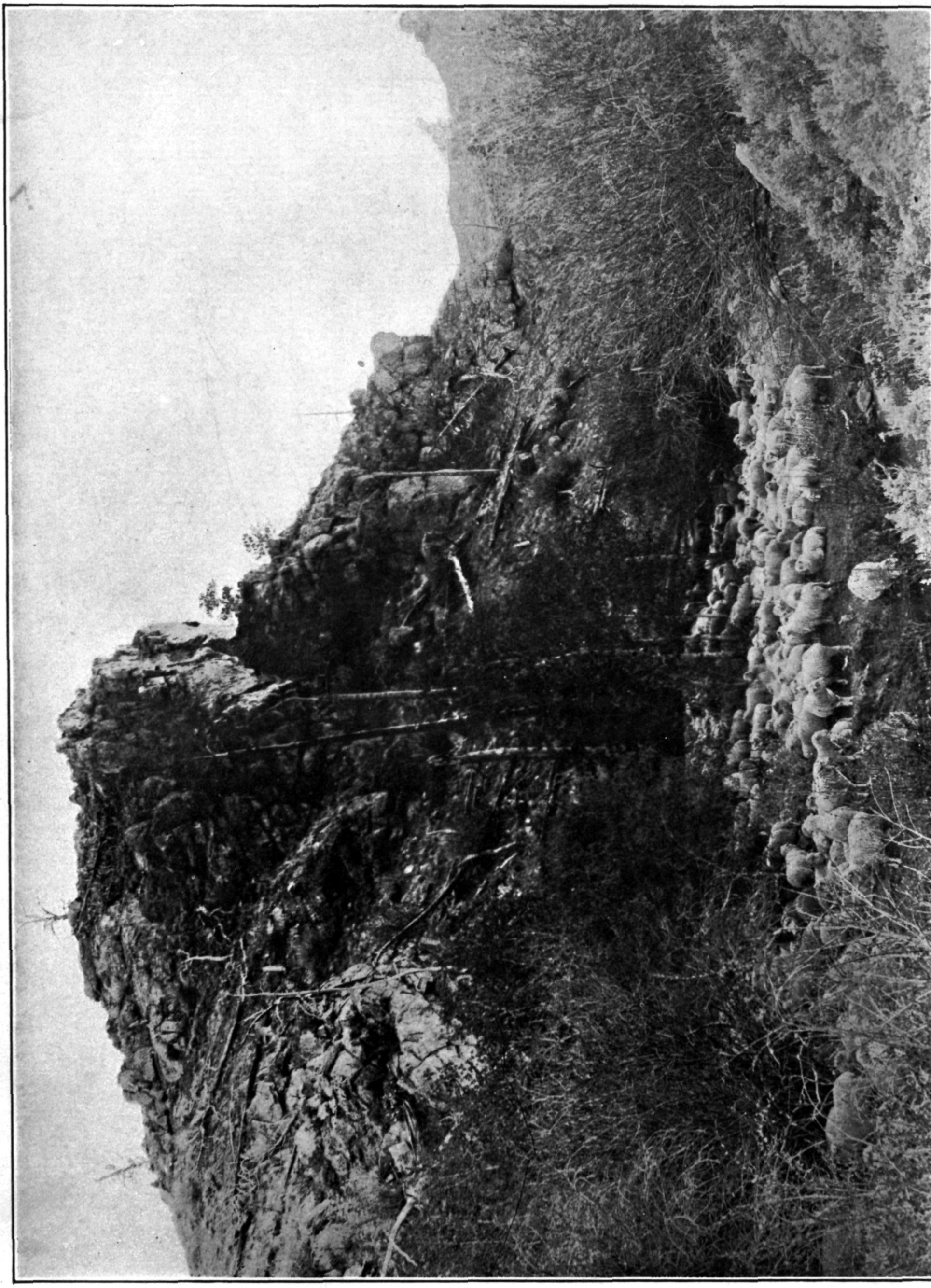

LAMBING GROUNDS IN WYOMING.

Photograph furnished by Wm. F. Pflaeging.

U. S. DEPARTMENT OF AGRICULTURE.

TWENTIETH ANNUAL REPORT

OF THE

BUREAU OF ANIMAL INDUSTRY

FOR

THE YEAR 1903.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

[Public—No. 15.]

AN ACT providing for the public printing and binding and the disposition of public documents.

Sec. 73. Extra copies of documents and reports shall be printed promptly when the same shall be ready for publication, and shall be bound in paper or cloth, as directed by the Joint Committee on Printing, and shall be the number following in addition to the usual number.

Of the report of the Bureau of Animal Industry, 30,000 copies, of which 7,000 shall be for the Senate, 14,000 for the House, and 9,000 for distribution by the Agricultural Department.

Approved, January 12, 1895.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., May 10, 1904.

Sir: I have the honor to submit herewith the Twentieth Annual Report of the Bureau of Animal Industry, prepared in accordance with the organic act creating the Bureau, and recommend that it be forwarded to the Public Printer for printing.

Respectfully,

D. E. Salmon,
Chief of Bureau.

Hon. James Wilson,
Secretary.

ORGANIZATION OF THE BUREAU OF ANIMAL INDUSTRY.

Chief: D. E. Salmon, D. V. M.
Assistant chief: A. D. Melvin, D. V. S.
Chief clerk: E. B. Jones, LL. M., M. D.
Dairy division: Henry E. Alvord, C. E., chief; C. B. Lane, B. S., assistant chief.
Inspection division: A. M. Farrington, B. S., B. V. S., chief.
Quarantine division: Richard W. Hickman, Ph. G., V. M. D., chief.
Editor: George Fayette Thompson, M. S.
Artist: W. S. D. Haines.
Expert in animal husbandry: George M. Rommel, B. S. A.
Librarian: Beatrice C. Oberly.

LABORATORIES.

Biochemic division: E. A. de Schweinitz, Ph. D., M. D., chief; Marion Dorset, M. D., assistant chief.

Pathological division: John R. Mohler, A. M., V. M. D., chief; Henry J. Washburn, D. V. S., acting assistant chief.

Zoological division: Ch. Wardell Stiles, M. S., A. M., Ph. D., consulting zoologist in charge.

EXPERIMENT STATION.

Superintendent, E. C. Schroeder, M. D. V.; expert assistant, W. E. Cotton.

CONTENTS.

TWENTIETH ANNUAL REPORT OF THE BUREAU OF ANIMAL INDUSTRY.

REPORT OF THE CHIEF OF THE BUREAU.[a]

TUBERCULOSIS.

During the past year the work which was begun in the Biochemic Division in the spring of 1902 to determine the infectiousness of human tuberculosis for cattle has been completed. The results show that of 9 freshly isolated cultures of human tuberculosis from various sources, 2 were fully equal to a freshly isolated bovine culture in their pathogenic power for cattle, and in addition possessed no cultural or morphological characters sufficiently marked or constant to permit of a distinction being made between them and the organism of bovine origin. Both of these virulent human cultures were derived from children who died of generalized tuberculosis. It is interesting to note that among the 4 cultures obtained from children, 2, or 50 per cent, were quite the equal of the bovine bacillus in their pathogenic power for cattle. All of these cultures have been carefully compared with reference to their virulence for cattle, hogs, rabbits, and guinea pigs. Steps have been taken to push to completion experiments which were begun in 1894 by Doctor de Schweinitz, chief of the Biochemic Division, and in which he apparently succeeded in establishing considerable immunity from tuberculosis in cattle by a previous inoculation with attenuated human tubercle bacilli. If this work proves to be successful in a practical way, it may be of great benefit to the cattle raisers of this country. In connection with other work, experiments have been inaugurated whereby it is hoped to obtain a method for cultivating rapidly, from sputum, tubercle bacilli which are so few in number as to escape detection by a microscopic examination. Such a method would be of great value in the diagnosis of doubtful cases of tuberculosis.

The question of the infectiousness of mammalian tubercle bacilli for fishes has also been taken up and is being studied experimentally, but this work is as yet incomplete. The experiments looking to the production of an antitoxic serum for tuberculosis are being continued.

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[a] The report of the chief of Bureau is for the fiscal year 1902–03.

During the fiscal year just ended the Biochemic Division has prepared and sent out free of charge to health officers 47,358 doses of tuberculin to the different States and Territories (including England) as follows:

Distribution of tuberculin.

	Doses.		Doses.
California	558	Montana	996
District of Columbia	438	New Jersey	2,121
England	900	New York	111
Georgia	18	North Carolina	390
Illinois	6	North Dakota	192
Iowa	202	Ohio	378
Kansas	147	Oregon	132
Kentucky	30	Vermont	10,818
Maine	104	Virginia	78
Maryland	360	Washington	396
Massachusetts	5,832	West Virginia	36
Michigan	249	Wisconsin	1,008
Minnesota	21,732		
Mississippi	126	Total	47,358

The comparative study of tubercle bacilli from differing sources, which was inaugurated by the Pathological Division last year, has been pursued throughout the present fiscal year, but owing to the adoption of the subcutaneous method for the inoculation of the experimental animals and the slow growth of the organism of tuberculosis, both upon culture media and in the inoculated animal, the work will not be completed for some time.

As the result of the appearance of a gastrointestinal disturbance in endemic form among the midshipmen of the United States Naval Academy last winter, and which was traced to the milk supply, the commandant of the academy requested the cooperation of this Bureau with the view of adopting such measures as would prevent a repetition of the trouble. A visit to the farm which supplied the milk to the students revealed a highly unsanitary condition of the premises and the presence of certain cows in the herd which exhibited clinical evidence of tuberculosis. The offending features in the stable, well, and dairy house were corrected and the tuberculin test applied to the herd of 62 animals, 36 of which reacted. The tubercular cattle were subsequently slaughtered at a Baltimore abattoir, under the supervision of an official of this Bureau, and the diagnosis made by the tuberculin test was confirmed.

Tuberculosis was studied from many different sides at the Experiment Station of the Bureau and a number of important conclusions reached. It was shown that tubercle germs from human sources, on subcutaneous injection, frequently, but not always, fail to produce generalized tuberculosis in cattle; that tubercle germs which fail to

cause tuberculosis in cattle on subcutaneous injection produce local abscesses, in which the tubercle germs retain their virulence for long periods of time; that tubercle germs which cause progressive tuberculosis in cattle on subcutaneous injection do not produce abscesses, but, on the contrary, cause typical tubercular lesions at the seats of injection; that cattle which have been exposed to tubercular infection, either by injection or feeding, may react positively to tuberculin for a considerable period of time, even when no lesions of disease, attributable to the exposure, can be detected by the most careful post-mortem examination; that intravenous injections of tubercle germs of a kind which do not possess the power to produce a typical tuberculosis in the subjects injected cause an extensive disease, especially in the lungs, which gradually ends in recovery. It is not known how long virulent tubercle germs remain in the tissues of these seemingly recovered animals, but from some observations made at the station it is fair to assume that germs are still present long after apparently perfect health has been reestablished. In one instance human germs injected into the udder of a cow, through the teat, caused a disease which disappeared after several months, but the material which was taken from the udder a year later still caused fatal, generalized tuberculosis in guinea pigs on subcutaneous injection.

One experiment made at the station regarding the rapidity with which tuberculosis may spread in a herd of cattle upon the introduction of a tubercular cow deserves special attention. In a stable containing 10 box stalls, with high 2-inch plank walls, 7 healthy cattle were confined with 3 tubercular cows. Two of the healthy cattle occupied the same stalls constantly and 5 frequently occupied stalls previously used by the tubercular cattle. After six months 6 of the 7 healthy cattle had contracted tuberculosis. The seventh animal, which escaped, had received vigorous preventive treatment before it was exposed. The 2 animals which at no time entered the stalls infected directly through being occupied by diseased cattle were among the 6 animals which became affected. This experiment shows the great care which must be exercised against the introduction of tubercular cattle into healthy herds, and that a healthy herd may become entirely tubercular, if the proper precautions are neglected, in a very short time.

TUBERCULIN TEST IN ENGLAND.

The official veterinarian stationed at London, England, in accordance with the requirements of Bureau of Animal Industry Order No. 79, dated November 10, 1900, providing for the testing with tuberculin, by an inspector of this Bureau, of all cattle over 6 months old which are to be imported into the United States, has tested of the different

breeds of purebred cattle in various parts of Great Britain 631 cattle, of which 533 passed and 98 were rejected, as follows:

Results of tuberculin test of cattle in England for importation.

Breed of cattle.	Passed.	Rejected.	Breed of cattle.	Passed.	Rejected.
Shorthorn	91	29	Dexter Kerry	18	0
Jersey	151	23	Highland	16	[a]3
Aberdeen-Angus	89	33	Sussex	1	0
Guernsey	33	2	Total	533	98
Hereford	105	2			
Galloway	29	6			

[a] Tested in United States quarantine station.

In view of the fact that tuberculosis has not been found to occur among the native cattle on the islands of Jersey and Guernsey, the cattle to be imported directly from these islands into the United States were exempted from the tuberculin test by amendment No. 12 to Bureau of Animal Industry Order No. 56, dated October 25, 1902.

FOOT-AND-MOUTH DISEASE.

A report of the outbreak of this disease in New England in the fall of 1902 appeared in the Nineteenth Annual Report of this Bureau, and in order to have it as complete as possible the data were brought down to the month of June, 1903. The statistics relative to this disease, which appeared in my report for the fiscal year ended June 30, 1903, are somewhat more complete than those published in the Nineteenth Annual Report, and they are therefore reproduced below:

Number of herds and cattle affected with foot-and-mouth disease since the beginning of the outbreak, as reported by months.

Month.	Massachusetts.		New Hampshire.		Vermont.		Rhode Island.		Total.	
	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.
November, 1902 [a]	62	1,219			4	47	7	234	73	1,500
December, 1902	71	1,536	4	37	17	288	8	110	100	1,971
January, 1903	9	225							9	225
February, 1903	6	196			1	16	3	16	10	228
March, 1903	3	55	28	444					31	499
April, 1903	3	9	15	221					18	230
May, 1903	2	28	1	31					3	59
Total	156	3,268	48	733	22	351	18	360	244	4,712

[a] These are the figures of official record, but it is known in a general way that there were more animals affected previous to November.

Cattle, hogs, sheep, and goats slaughtered by United States Department of Agriculture.

State.	Herds.	Cattle.	Hogs.	Sheep and goats.	Total animals.
Massachusetts	129	2,708	229	55	2,992
New Hampshire	48	733	68	100	901
Vermont	22	351	55	74	480
Rhode Island	6	80	8	....	88
Total	205	3,872	360	229	4,461

Appraised valuations and compensation paid for animals slaughtered.

States and animals.	Number.	Appraised value on health basis.	Average per head.	Net compensation (70 per cent).	Average per head.
Massachusetts.					
Cattle (not including calves)	2,589	$131,238.58	$50.69	$91,867.00	$35.48
Calves	119	1,021.79	8.59	715.25	6.01
All cattle	2,708	132,260.37	48.84	92,582.25	34.19
Hogs	229	2,269.43	9.91	1,588.60	6.94
Sheep and goats	55	444.00	8.07	310.80	5.65
Total	2,992	134,973.80	....	94,481.65	....
New Hampshire.					
Cattle (not including calves)	668	28,704.00	42.97	20,092.80	30.08
Calves	65	539.00	8.29	377.30	5.80
All cattle	733	29,243.00	39.90	20,470.10	27.93
Hogs	68	574.50	8.45	402.15	5.91
Sheep	100	497.00	4.97	347.90	3.48
Total	901	30,314.50	....	21,220.15	....
Vermont.					
Cattle (not including calves)	301	....	....	9,348.00	31.06
Calves	50	....	....	590.00	11.80
All cattle	351	....	....	9,938.00	28.31
Hogs	55	....	....	429.32	7.81
Sheep	74	....	....	325.75	4.40
Total	480	....	....	10,693.07	....
Rhode Island.					
Cattle (not including calves)	79	3,523.00	44.59	2,466.10	31.22
Calves	1	3.00	3.00	2.10	2.10
All cattle	80	3,526.00	44.08	2,468.20	30.85
Hogs	8	65.00	8.12	45.50	5.69
Total	88	3,591.00	....	2,513.70	....

SUMMARY.

Animals.	Number.	Net compensation.	Average per head.
Cattle (not including calves)	3,637	$123,773.90	$34.03
Calves	235	1,684.65	7.17
All cattle	3,872	125,458.55	32.40
Hogs	360	2,465.57	6.85
Sheep and goats	229	984.45	4.30
Total compensation paid	....	128,908.57	....

INSPECTIONS UNDER QUARANTINE REGULATIONS.

The Inspection Division reports that, under the requirements of the quarantine regulations, there were issued, from February to June, 9,699 permits for the removal of wool and hides; that from December to June, 4,654 cars were cleaned and disinfected in the quarantined States; that 10,348 empty cars were sealed without disinfection and returned to the West; that 12,618 cars carrying live stock from the West into or through the quarantined States were sealed.

A VENEREAL DISEASE OF HORSES, THE SO-CALLED MALADIE DU COÏT.

The work in this connection has been vigorously prosecuted during the year under the immediate direction of the Miscellaneous Division, and at its close we are encouraged to hope through what has been accomplished that it will eventually, and not at a very remote period, be entirely stamped out. Numerous obstacles to the accomplishment of this end have been found quite difficult to overcome, among which may be mentioned the semiwild condition of much of the country over which the disease had spread, the wild state in which most of the animals existed, and the lack of cooperation and aid by the owners throughout the worst infected sections, these being in and adjacent to the Indian reservations of South Dakota. Previous to the annual round-up season on the ranges in and about the Pine Ridge and Rosebud Indian reservations organized preparations were made for the inspection of all the horses owned by the Indians and others in the territory named. Inspection camps were inaugurated, one for each of the several districts throughout the reservations. This arrangement made possible the inspection of practically all horses running at large on these ranges; thus the advantages to be gained in a great part were availed of, and animals which habitually ran at large on the open range, a great majority of which had never been handled, were subjected to careful veterinary examination, as in the case of those usually kept in barns or inclosed pastures.

During the round-up season from June 1 to June 30, 1903, 9,455 horses were examined; 173 were slaughtered because of showing evidences of the disease, 6 of which were stallions and 167 mares. In addition, 1,270 stallions running at large, these being the most effective spreaders of the disease, were castrated, and 185 stallions to be used for breeding purposes were tagged for identification. During the year the total number of animals inspected was 16,287; number found diseased and slaughtered, 511; number quarantined as suspicious, 277; number of stallions castrated, 1,889. The average price paid by the Department for 474 animals slaughtered because of being diseased was $17.52, and the total $8,308, leaving 37 animals to be paid for, owners unknown at present or settlement in course of adjustment. Castra-

tions, having been performed by employees of the Bureau, incurred no expense, and because of this operation the possibility of the transmission of the disease through the animal operated on was removed.

Under date of January 20, 1903, the Secretary of Agriculture issued an order prohibiting the transportation or movement of any horses in the counties of Dawes, Boxbutte, Sheridan, and Cherry, in the State of Nebraska, and in the Pine Ridge and Rosebud Indian reservations and the counties of Custer and Fall River, S. Dak., to any other State or Territory or the District of Columbia unless first inspected by an inspector of this Bureau and accompanied by a certificate issued by the said inspector.

On March 10, 1903, the Secretary of Agriculture, with the concurrence of the Secretary of the Interior, issued an order which was posted throughout the above-named Indian reservations, prohibiting any stallion or stallions from running at large within the bounds of these reservations; also directing that any uncastrated male horse one year of age or older found running on the range or at large in these reservations be castrated, and that all stallions belonging to owners living on White Clay Creek, or within 1 mile thereof, should either be castrated or kept under close quarantine until further orders; also prohibiting, furthermore, the breeding of horses in herds in which diseased animals had been found, under any circumstances, whether in fenced pastures, inclosures, or otherwise, and directing, with a provision for appraisement and indemnity to owners, that any animal or animals showing symptoms of maladie du coït, or known to have been exposed to the disease, shall, in the discretion of an inspector or employee of this Department, be immediately quarantined, and maintained in quarantine at the expense of the owner or owners until released by the inspector or condemned and slaughtered, with a statement to the effect that any person, company, or corporation knowingly violating the provisions of this order is guilty of a misdemeanor, and on conviction liable to a fine of not less than $100 nor more than $1,000, or to imprisonment not more than one year, or to both such fine and imprisonment.

As a result of the work that has been done during the year and the thoroughness of method which has obtained in its prosecution, we are encouraged to believe that the disease in the counties of Boxbutte, Dawes, Sheridan, and Cherry, Nebr., is practically stamped out. Numerous herds in which the disease has been found in these counties are being kept under surveillance, and while it seems almost inevitable that a case here and there may occur, we feel that the Bureau now has the disease well in hand and under control. The last remark applies likewise to the Indian reservations, as all stallions left for breeding purposes are tagged with a quarantine tag, kept under quarantine restrictions, and regularly inspected, so that should the disease

develop at any point it will be promptly detected, which should not admit of a possibility of its spread. In the counties of Custer and Fall River, S. Dak., the disease was introduced and disseminated by an irresponsible class of horse traders, who made it their business to procure Indian ponies from the reservations and trade them off to settlers living on adjacent territory. The disease here, fortunately, is not very prevalent; but all stallions have been ordered off the range, and in most instances there has been compliance on the part of owners. This range is very difficult to work, owing to its mountainous character, notwithstanding which the inspector in charge states that in all territory known to be infected the disease is well in hand, and the usual conservatism of this inspector, Dr. E. T. Davison, in making statements of this character, leads to the belief that it will not again get beyond control at any point, but, on the contrary, will ultimately, and not at a very distant date, be entirely stamped out.

Investigations and experiments have been continued throughout the year at the pathological laboratory and at the Experiment Station of this Bureau, under the direction of Dr. John R. Mohler, chief of the Pathological Division, by means of specimens consisting of diseased organs and a diseased living mare brought from the infected section of country to Washington, D. C. Doctor Mohler has likewise on two occasions visited the infected country for the purpose of making personal observations of the malady as it occurs there in its various phases. It is expected, therefore, that in the course of the fiscal year upon which we are about to enter the results of the work that has been done in this connection, together with the technique followed in its prosecution, may be issued in bulletin form for the information of those interested in this important subject from an economic as well as from a scientific standpoint.

RABIES.

The continuous existence in the District of Columbia of the contagion of rabies, a disease which is capable of being controlled only by the enforcement of proper regulations, is a serious condition, and methods for its suppression are worthy of serious consideration at the present time. Not since 1900, when rabies was so prevalent in this vicinity, has such a large number of rabid animals been referred to this Bureau and investigated by the Pathological Division. During the past year 51 investigations for the purpose of determining the presence or absence of rabies in various animals were made. The animals included in the above consisted of 37 dogs, 6 cattle, 2 horses, 1 fox, 3 wolves, 1 bear, and 1 rabbit, the latter having bitten a small girl. Of these, 38 gave positive results, either by animal inoculations or by the microscopic examinations of sections of the plexiform ganglia. The latter method has proved very valuable, as a diagnosis

can be made usually within forty-eight hours; but the ganglion should be perfectly fresh, owing to the histological changes being obliterated when putrefaction occurs. The 29 cases below recorded as originating in the vicinity of Washington, D. C., can not be considered as representing the extent of rabies in the District of Columbia, since distinctive cases frequently occur in the practices of local veterinarians, the diagnoses of which require no confirmation. It is only those cases which are atypical, or where persons have been bitten, or owners skeptical of the diagnosis, that the Bureau is called upon to investigate. It will be further noticed that an unusual percentage of the cases received proved to be rabid. This is due to the fact that only those animals showing a fairly characteristic history of rabies, or where the animal had been vicious and bit other animals or persons, or for obviously interesting reasons, were used for diagnostic purposes. This method of procedure was decided upon, as the labor involved on unimportant cases with doubtful histories did not seem to be justified. The following positive results have been obtained from suspected cases of rabies:

Results of inoculation tests and microscopic examinations for rabies.

Date.	Record No.	Kind of animal.	Received from—	Rabbits inoculated.	Result of inoculations.	Diagnosis by histological examination.	Persons or animals bitten.
1902.							
July 3	254	Dog	Balls Hill, Va	2	Positive	None made.	2 dogs.
July 16	255	do	District of Columbia	2	do	do	
July 20	257	Cow	do	2	do	do	
Aug. 1	258	Dog	Fort Myer, Va	2	do	do	
Aug. 12	260	do	District of Columbia	2	do	do	Do.
Aug. 23	261	do	do	2	do	do	Boy and dog.
Sept. 11	262	Fox	do	2	do	do	
Sept. 12	263	Dog	do	2	do	Positive	Girl.
Oct. 1	265	do	do	2	do	do	Woman.
Oct. 22	268	do	Easton, Md	2	do	do	
Nov. 3	269	do	District of Columbia	2	do	do	
Nov. 7	270	do	do	2	do	do	Boy.
Nov. 11	271	Cow	do	2	do	None made.	
Nov. 21	272	Dog	do	2	do	Positive	3 men.
Nov. 29	273	do	do	2	do	do	Girl.
Dec. 12	274	Steer	Atoka, Ind. T	2	do	None made.	
Dec. 13	275	Cow	Boston, Va	2	do	do	
Dec. 13	277	Horse.	Frankfort, Ind	2	do	do	
Dec. 30	279	Wolf	District of Columbia	2	do	Positive	
1903.							
Jan. 10	280	Dog	District of Columbia	3	do	None made.	2 dogs.
Jan. 17	281	Wolf	do	2	do	do	
Jan. 22	282	Dog	Biltmore, N. C	2	do	Positive	2 men.
Jan. 23	283	do	District of Columbia	2	do	do	1 man and 2 dogs.
Feb. 6	284	do	do	2	do	None made.	
Feb. 20	286	Wolf	do	2	do	do	
Mar. 30	289	Dog	do	2	do	Positive	Boy.
Apr. 14	290	do	do	2	do	do	Do.

Results of inoculation and microscopic examinations for rabies—Continued.

Date.	Record No.	Kind of animal.	Received from—	Rabbits inoculated.	Result of inoculations.	Diagnosis by histological examination.	Persons or animals bitten.
1903.							
Apr. 17	291	Dog	District of Columbia	2	Positive	Positive	Boy.
Apr. 20	292	do	Philips Hill, Md	2	do	do	Do.
Apr. 21	293	do	District of Columbia	2	do	do	
May 11	294	do	do	2	do	do	
May 13	295	Steer	Shepherdstown, W. Va.	2	do	None made.	
May 16	296	Dog	District of Columbia		None made.	Positive	3 persons.
June 5	299	do	do	2	Positive	do	
June 9	300	do	Norfolk, Va	3	do	do	Man.
June 10	301	do	District of Columbia	2	do	do	Boy.
June 24	302	do	Norfolk, Va		None made.	do	
June 24	303	do	do	2	Positive	do	2 dogs, 2 hogs, 2 hens, and 1 calf.

BLACKLEG INVESTIGATIONS.

The preparation and distribution of blackleg vaccine have continued to be very important parts of the routine work performed in the pathological laboratory, and have followed along the same lines as during the previous year. The demand for this preventive remedy continues to increase, while the results obtained by the use of the vaccine are practically the same as for former years. The quantity of blackleg vaccine distributed among stock owners during the past year and the immunizing effect produced upon cattle by the vaccine distributed in the previous year are indicated in the appended tables:

Doses of vaccine distributed during the fiscal year ended June 30, 1903.

	Doses.
July 1 to December 31, 1902:	
July	65,675
August	96,385
September	180,075
October	279,170
November	233,785
December	150,820
January 1 to June 30, 1903:	
January	102,820
February	105,480
March	144,210
April	184,800
May	103,690
June	82,190
Total	1,729,100

Results obtained from vaccine distributed during the fiscal year ended June 30, 1902.

State or Territory.	Number of reports.	Number of cattle vaccinated.	Deaths same season previous to vaccination.		Died after vaccination.					
			Number.	Per cent.	Within 48 hours.	From 2 to 7 days after.	Within 1 year.	Number of cases due to mistakes.	Total number.	Percentage of deaths.
Arizona	20	1,661	84	5.05	4	2	4	....	10	0.60
Arkansas	5	698	35	5.01	....	....	1	....	1	.14
California	132	25,083	906	3.61	5	70	145	7	227	.90
Colorado	549	76,846	1,532	1.99	14	52	284	17	367	.47
Idaho	25	2,383	188	7.88	1	6	11	....	18	.75
Indian Territory	109	20,254	690	3.4	6	21	45	....	72	.35
Iowa	131	8,215	325	3.95	8	11	25	2	46	.55
Kansas	999	86,020	1,881	2.18	32	98	372	....	502	.58
Kentucky	20	1,330	67	5.04	....	1	1	....	2	.15
Minnesota	46	5,044	105	2.08	....	5	27	....	32	.63
Missouri	352	17,344	522	3	6	32	90	....	128	.73
Montana	227	26,497	560	2.11	7	13	112	23	155	.58
Nebraska	1,644	128,009	3,338	2.6	57	101	705	2	865	.67
New Mexico	26	5,716	224	3.91	2	4	22	18	46	.80
North Dakota	367	44,210	972	2.19	15	14	196	....	225	.50
Oklahoma	154	22,057	692	3.13	5	22	66	15	108	.48
Oregon	25	2,762	105	3.8	1	4	8	....	13	.47
South Dakota	480	42,639	1,409	3.3	28	19	81	6	134	.31
Tennessee	30	1,558	68	4.36	2	2	5	....	9	.57
Texas	866	198,415	5,063	2.55	80	213	927	51	1,271	.64
Utah	14	1,813	60	3.3	2	....	2	....	4	.22
Virginia	185	7,281	257	3.52	4	17	48	....	69	.94
Washington	40	1,855	82	4.42	1	1	14	....	16	.86
West Virginia	64	2,107	82	3.89	1	....	6	....	7	.33
Wyoming	267	40,960	1,226	2.99	13	59	137	9	218	.53
Other States	89	5,120	403	7.87	7	2	12	....	21	.41
Total	6,866	775,877	20,876	2.69	301	769	3,346	150	4,566	.59

It will be observed from the above table that 301 animals died within forty-eight hours of the time when they were vaccinated. It is probable that these cattle were infected with blackleg at the time of the injection, and, as the vaccine is a preventive, not a curative agent, this number should be deducted from the total number of deaths following vaccination. Mistakes have been made by stock owners in vaccinating their cattle, and should be eliminated in determining the immunizing value of the vaccine, but it is interesting to note the very small number made in comparison with the large number of cattle vaccinated. After deducting the number of cattle that died within forty-eight hours and those deaths that were admitted to be due to mistakes, the number of cases that died after vaccination is reduced to 4,115, or 0.53 per cent.

GLANDERS.

The preparation of mallein by the Biochemic Division has been continued, and during the year 7,331 doses have been shipped to the various States and Territories as follows:

	Doses.		Doses.
California	204	North Dakota	210
Colorado	36	Ohio	6
Delaware	36	Oklahoma	30
District of Columbia (War Department)	3,000	Philippine Islands	20
Illinois	976	Porto Rico	160
Iowa	124	Rhode Island	3
Kansas	16	South Dakota	43
Massachusetts	6	Utah	6
Michigan	12	Vermont	165
Minnesota	1,206	Washington	52
Mississippi	30	Wisconsin	108
Missouri	6	Wyoming	6
Montana	864	Total	7,337
North Carolina	12		

HOG CHOLERA AND SWINE PLAGUE.

The investigations concerning these two diseases have been continued. Some new and practical points of value have been determined, and efforts are being made to prepare a suitable vaccine for these diseases. The endeavors to secure a practicable antitoxin are also being continued, and work along other lines is being pushed as rapidly as is possible.

MYCOTIC ENTERITIS.

During the past autumn numerous reports from various sections of the country reached the Bureau of a fatal disease among cattle, showing uniform symptoms. An investigation in response to an urgent request from central Virginia showed the trouble to be mycotic enteritis, due to eating moldy corn fodder, and a change of food with appropriate treatment checked the affection. This moldy condition of the food last fall seemed to be quite prevalent, and could be held responsible for the disease in question in a number of instances.

LEUCOENCEPHALITIS IN HORSES.

Numerous letters were received from South Carolina and Georgia last winter urging an early investigation of a fatal malady of horses in that section. Five brains were received from typical cases of this disease, and a microscopic examination in the Pathological Division revealed those lesions that occur in epizootic leucoencephalitis.

CALF DIPHTHERIA.

An infectious pseudomembranous inflammation of the tongue and lips of young cattle has occurred in epizootic form in many places in

the West. While easily amenable to treatment, it has, when neglected, proved rapidly fatal, and has thus been the cause of considerable loss where not quickly recognized or where its nature was not fully understood. Investigations were made in the laboratory of the Pathological Division of portions of necrosed tissue sent in from the field. Microscopically they presented the pathological alterations so characteristic of calf diphtheria, namely, coagulation necrosis, the line of demarcation between healthy and diseased tissues being filled with bundles of long, undulating, beaded filaments, the *Bacillus necrophorus*.

ULCERATIVE STOMATITIS IN HOGS.

More or less allied to calf diphtheria is ulcerative stomatitis in hogs, known among stockmen by the name of "sore mouth." This contagious malady appears frequently among sucking pigs and is quite fatal. Investigations looking to the cause of this disease and also to the question of its relationship or identity with calf diphtheria are now in progress.

FOOT ROT IN SHEEP.

This disease, known to the sheep owners of the United States since the earliest importations of improved breeds and which still exists with greater or less severity among many flocks of the country, was so troublesome in the Middle Atlantic States during the year that further study of its cause was considered advisable.

From the interdigital pustules of some affected animals owned in Maryland culture media were inoculated and an attempt made by the Pathological Division to isolate the specific organism to which foot rot may be due. The outbreak of foot-and-mouth disease in the New England States interrupted this work and it is still unfinished, but enough has been done to prove that the organism which causes foot rot in sheep can be cultivated artificially for several generations without losing its virulent properties. Material obtained in September was at once sown in bouillon and the resulting mixed cultures were transplanted at intervals until early in November, at which time the third generation had been reached. These cultures would produce foot rot in healthy animals, the lesions appearing on the eighth and tenth day after the application of the culture to the slightly irritated skin in the cleft of the foot.

First a moist condition of the surface of the skin was noticed, followed by the appearance of various inflamed spots, which rapidly spread and coalesced. Within twenty-four hours of the appearance of the reddened spots the characteristic burrowing propensities of the disease were in full evidence, and the hoofs were soon undermined.

It was only by the use of mixed cultures that the lesions could be produced, and the isolation of the one specific cause remains for future accomplishment.

DIPPING CATTLE FOR TICKS.

The question concerning an effective tick dip for cattle has received further consideration at the Experiment Station of the Bureau, and very encouraging results have been obtained from the use of one substance. Three experiments have been made to test the value of natural mineral oil from Texas as a tick dip. The fact that the tick family is generally supposed to be very susceptible to the action of sulphur, and that the oil from the Texas wells was reported to be saturated with sulphur, led to the use of this oil.

The total number of animals dipped was necessarily small—12 to 14 young cattle. In every instance all the ticks were killed and the skins of the animals only very slightly and not at all seriously affected. The results obtained are such that a more extensive test of the oil should be made than is possible at the station. In station tests ticks raised in flasks were used, and the weather during the tests was not so warm as it commonly is during the summer months in the permanently infected tick territory. Ticks which have been grown under more natural conditions than the Bureau methods of raising them may be more resistant to the oil, and in a warmer climate the effects of the oil on the skins of the cattle may be more serious. These points should be tested by one or two large dipping experiments in the South, and, until such experiments have been made and have confirmed the station results, the oil can not be recommended for general use.

COOPERATION WITH NATIONAL ZOOLOGICAL PARK.

Zoological gardens are becoming a feature in all large cities, and many even smaller communities have their collections of wild animals. Therefore, all matters concerning the diseases of these animals in captivity are of general interest and of economic importance.

A new phase of work this year has been the cooperation of the pathological laboratory with the National Zoological Park. This has meant the autopsy of all fatal cases, the investigation of the causes of death among the animals, and the advising of preventive measures in certain cases. While no autopsy has been without its instructive features, some have been of peculiar pathological interest.

Most of the causes of death in the larger animals proved to be the result of gastrointestinal disorders, due no doubt to the enforced unnatural conditions in which they were necessarily kept, especially those relating to diet and confinement. The animals succumbing to these troubles were 5 buffaloes, 3 bears, 3 lynxes, and 1 monkey. The diseases due to infection varied widely, and from the histories obtained several of the animals at least were already affected when acquired by the park authorities. Thus, tuberculosis caused the death of 1 peccary, 1 agouti, and 1 monkey, while aspergillosis produced the death

of a flamingo. Rabies also caused a serious loss. Attention was first directed to a den of foxes, the animals in which suddenly developed marked fighting propensities. Only one case was used for diagnostic purposes, and as soon as the trouble was recognized the remaining foxes in this den were killed. Later on 3 wolves were affected with rabies, and a striking circumstance was the capture of a large stray dog in the park, likewise affected. This occurred after the outbreak among the wolves and foxes, but it shows a probable source from which these confined animals may have become affected.

The following deaths were due to pneumonia: One caribou, 1 baboon, 1 kangaroo, 1 antelope, and 1 monkey. An agouti died of carcinomatosis, a llama succumbed as a result of diaphragmatic hernia, while parasitism (*Strongylus contortus*) was the only apparent cause of death in a Rocky Mountain sheep. Five necropsies have been held on snakes, which have resulted in identifying two different diseases as causes of death. Three of them died as a result of abscess formation due to the entrance of a bacillus which has been isolated but not yet identified. The blood of 2 of the above contained large numbers of the reptilian protozoan of Danilewsky, but probably not in sufficient quantity to produce death.

The other two deaths were caused by a hemorrhagic septicemia associated with intense edema due to the presence of *Bacillus hydrophilus fuscus* Sanarelli. This organism produces a highly virulent septicemia among frogs and other cold-blooded animals, as well as among the smaller domestic animals. Feeding experiments conducted in this laboratory as well as elsewhere gave negative results. The mass of evidence emphasizes the entrance of the germ through lesions upon the external surface; hence the fact that *B. hydrophilus* is a water organism makes the recognition of its presence in any animal in captivity of interest as involving the contamination of certain waters, and being a possibility to be thought of in cases of rapid death among the smaller animals.

POULTRY-FEEDING EXPERIMENTS.

In order to obtain in a scientific manner some practical data for use in poultry feeding, a series of experiments has been conducted in the Biochemic Division in which an effort has been made to determine the comparative value of corn, wheat, and oats as poultry foods. The results obtained indicate that the crude proteid and nitrogen-free extract of corn are more easily assimilable than those of oats. The crude fat of corn also seems to be more assimilable for chickens than that of wheat or oats. The use of corn alone has given more satisfactory results than either wheat or oats. This appears to be due chiefly to the fact that it is more palatable, and for this reason there is a somewhat greater consumption of the nutritive material. Corn can be fed

at a much lower cost than wheat or oats. The details of these experiments, together with data for the establishment of practical, fixed rations, are given in a bulletin which has just been completed.[a]

QUARANTINES AT PORTS OF ENTRY.

The Miscellaneous Division (which became the Quarantine Division on July 1, 1903), under the immediate supervision of Dr. R. W. Hickman, has charge of the work connected with the quarantines at the several ports of entry, as well as the records of tuberculin tests in England, referred to elsewhere.

QUARANTINE STATION FOR THE PORT OF NEW YORK.

New York, being the chief seaboard port, is most frequently chosen by importing breeders as the port of entry for animals requiring inspection and quarantine. The work at the new animal quarantine station for this port, located at Athenia, N. J., has been progressing favorably during the year, and much has been done in the way of adding to its completeness as a quarantine station as well as in enhancing its beauty and attractiveness. Situated as it is in the foothills of the Orange Mountains, 12 miles in a direct line from New York City, the grading of the grounds and avenues, the road building, the turfing of banks, the planting of trees and shrubs, together with the building of several new permanent stables, of the same attractive design and substantial construction as those previously erected, to replace the temporary buildings erected last year, materially contribute toward making this place what was intended in its inception, namely, the model animal quarantine station of America, and hence of the world. One of the features contributing to the picturesqueness of this section of country, and, indeed, to nearly the whole of northern New Jersey, has rendered the work of grading a portion of this tract rather slow and tedious. At near the center of the irregular oblong comprised in the 43 acres therein contained, running through its transverse diameter, there is a considerable ridge of brownstone covered with timber. In the face of this ridge quarries had been opened and worked at intervals extending back through many years, as shown by the growth of trees in some of the old holes partly filled with débris from the quarries and dirt that had washed into them. Thus, work that has been done here should be mentioned among the improvements; otherwise the changes wrought by converting this rough, rocky waste into a wooded slope of grazing ground could only be appreciated by those familiar with the conditions which existed when the Government purchased the land. At the top of this slope among the trees a new stone building has been erected to accommodate the pumping and water-supply apparatus and electric

[a] Published as Bulletin No. 56, Bureau of Animal Industry.

plant for the station and grounds; and toward the opposite side of the tract, in a wooded vale below, a large building 160 feet in length has been erected and especially fitted for hogs. In addition to this, the accommodations for animals to be quarantined now consist of permanent and temporary buildings as follows: Thirteen brick stables, with a cattle capacity of 317, and eight frame stables, with a cattle capacity of 283, making a total cattle capacity of 600. The Bureau has expended this year for additional buildings and improvements at Athenia $52,436.75, making the total cost thus far for the land (comprising 43 acres), buildings, and improvements about $113,436. Congress has appropriated $4,000 for the purchase of additional land, negotiations having been successfully conducted by Col. S. R. Burch, chief clerk of the Bureau, for two pieces containing about 9 acres, which separate the back or northeast corner of the station from the public road bounding its easterly side. This will prove a valuable addition, and make a total of about 52 acres in the station tract. The above appropriation becomes available July 1, 1903.

QUARANTINE STATION FOR THE PORT OF BOSTON.

The port of Boston was closed by order of the Secretary of Agriculture in November because of the occurrence of an outbreak of the contagious disease known as foot-and-mouth disease among animals in the States of Connecticut, Rhode Island, Massachusetts, and Vermont, in accordance with which Bureau of Animal Industry Orders Nos. 99 and 100 were issued under date of November 27, 1902, prohibiting the exportation from the port of Boston of cattle, sheep, or other ruminants or swine, and the movement of any of the above animals from or across the territory of any one of the above-named States. As a consequence, the entry of animals requiring quarantine at the port of Boston was limited to the first third of the fiscal year, and were as indicated in the succeeding table. Improvements at this station, located at Littleton, Mass., for the year consisted in necessary repairs to buildings, fences, and water-supply apparatus. For these $64.24 was expended.

QUARANTINE STATION FOR THE PORT OF BALTIMORE.

The land for this station, located at Halethorp, Md., as in the case of that for the port of Boston, is leased by the Department, and the expenses, apart from those incidental to the care of the property and animals quarantined there, have been likewise for necessary repairs, for which there has been expended $387.04. It is very desirable that a piece of land be purchased for a quarantine station for this port located on Chesapeake Bay, in order that import animals may be unloaded directly from steamers by means of barges without the necessity of their reshipment by rail to the quarantine station. Such a change in the present arrangements would probably permit of the safe

admission of importations of cattle, sheep, and other ruminants and swine from portions of the world now excluded, and which breeders of the various animals originating in such countries are exceedingly desirous to import. The last session of Congress appropriated $10,000 for the purchase of such a piece of land, which becomes available July 1, 1903, and steps will be promptly taken with a view to securing a suitable tract for this purpose.

ANIMALS QUARANTINED.

The following animals have all been subjected to inspection and quarantine, the length of the quarantine period imposed being fixed in accordance with the requirements of the Department regulations for the class or subdivision of the class to which they belonged:

Animals inspected and quarantined.

Station.	Cattle.	Sheep.	Hogs.	Station.	Cattle.	Sheep.	Hogs.
Littleton, Mass	39	6	8	Richford, Vt		5	
Athenia, N. J	549	577	95	Beecher Falls, Vt	60		1
Halethorp, Md	116			Island Pond, Vt		1	
Detroit, Mich	3	1		St. Albans, Vt	1	3	
Sault Ste. Marie, Mich	4			Houlton, Me	1		1
Ogdensburg, N. Y	6			Fort Fairfield, Me	47	24	5
Buffalo, N. Y	1		1	Eastport, Me	1	3	
Niagara Falls, N. Y	1			Lowelltown, Me		1	
Massena, N. Y	9			Vanceboro, Me	10	17	2
Cape Vincent, N. Y	4			Total	875	654	115
Newport, Vt	23	16	2				

There were also imported through the port of New York and quarantined under the supervision of the superintendent of the Athenia, N. J., quarantine station, 39 deer, 12 camels, 1 yak, 1 ibex, 2 wart hogs, 1 tapir, 7 antelopes, 2 moufflons, 4 llamas, 1 water buck, 2 zebus, 2 gazelles, 2 zebras, 1 Red River hog, 14 goats, 1 giraffe, 3 wild boars, 1 freak cow, 1 caribou, 1 reindeer, 1 anoa, and 11 miscellaneous ruminant show animals. In addition, 65 show animals were entered and inspected at the port of New York, belonging to Messrs. Barnum & Bailey, which were quarantined at their winter quarters at Bridgeport, Conn. There were imported through the port of Boston, Mass., and quarantined under the supervision of the superintendent of the quarantine station at Littleton, Mass., 2 deer, 1 antelope, and 1 goat; through the port of Ogdensburg, N. Y., 1 goat; through the port of Island Pond, Vt., 1 goat; and through the port of San Francisco, Cal., 4 guanacos and 2 alpacas. This makes a total of 1,831 imported animals that were quarantined.

The imports of animals from Canada not subject to quarantine at quarantine stations, but admitted upon inspection through the various

stations along the Canadian border, were 8,697 cattle, 163,427 sheep, 3,751 horses, 25,115 hogs, 11 moose, 1 deer, 14 asses, 3 mules, 5 goats, 3 camels, and 4 dogs—a total of 201,031.

ZOOLOGICAL WORK.

Owing to changes in the personnel of the Division of Zoology, the work there has been considerably interrupted. The chief of the division was transferred to the United States Public Health and Marine-Hospital Service in August, but has since been appointed consulting zoologist in charge, thus having general supervision of the work. The assistant chief was transferred in November to the field force of this Bureau. It was not until June that these two vacancies were filled, and on this account scientific investigations were interrupted, while the regular routine work of correspondence, determination of specimens, cataloguing of literature, etc., was continued.

The Division of Zoology, United States Public Health and Marine-Hospital Service, has been quartered in the zoological laboratory of this Bureau during the fiscal year just ended, so that the two divisions were practically conducted as one, the scientific work being done by the Marine-Hospital men.

HOOKWORM DISEASE IN UNITED STATES.

The most important piece of work undertaken was the demonstration of the frequency of hookworm disease (uncinariasis) in man in the United States, an investigation which had been started while the chief of the Division of Zoology, Doctor Stiles, was still in this Bureau, and which he completed after his transfer. The fact that a new species of parasite (*Uncinaria americana*), distinct from the Old World form (*Agchylostoma duodenale*), infests man in this country was first recognized by the Bureau of Animal Industry, and forms the basis of all the recent work upon the disease conducted in this country. It has now been shown that this disease is very prevalent in certain parts of the United States, especially among the farming classes of the sand districts of the Southern Atlantic States.

MEAT INSPECTION.

The inspection of cattle, sheep, calves, and hogs and their products was in operation at 155 abattoirs and packing houses in 49 cities. During the year inspection was started at 8 abattoirs, 3 of which are in 2 cities not before represented. Inspection had been withdrawn from, or business had been suspended at, 7 abattoirs before the end of the preceding year, thus lessening the number of cities by 2. There was a net increase of 1 abattoir over the previous year. Horses were inspected at 1 other abattoir.

The number of establishments and cities where meat inspection has been in operation since the work was begun is shown in the following table:

Establishments and cities where meat inspection was conducted, 1891 to 1903.

Fiscal year.	Number of establishments.	Number of cities.	Fiscal year.	Number of establishments.	Number of cities.
1891	9	6	1898	135	35
1892	28	12	1899	139	42
1893	37	16	1900	149	46
1894	46	17	1901	157	52
1895	55	19	1902	155	50
1896	102	26	1903	156	50
1897	128	33			

The following table shows the extent of the inspection of animals before they are slaughtered. The number of animals rejected on this inspection is also given. These animals are tagged and are held for further disposition; some are slaughtered immediately and are condemned or not according to their condition. Pregnant animals may be released to go to the country when there is no danger of spreading the contagion of any disease:

Antemortem inspections for the fiscal year 1903.

Kind of animal.	For official abattoirs in cities where inspections were made.	For abattoirs in other cities and miscellaneous buyers.	Total inspections.	Rejected, subject to result of post-mortem inspection.	
				At abattoirs.	In stock yards.
Cattle	6,213,783	5,774,977	11,988,760	771	40,489
Sheep	8,401,300	6,252,949	14,654,249	1,873	16,014
Calves	609,428	431,710	1,041,138	646	4,796
Hogs	21,707,381	9,838,841	31,546,222	3,037	58,260
Horses	344		344		
Total	36,932,236	22,298,477	59,230,713	6,327	119,559

The number of hogs inspected antemortem for official abattoirs fell from 25,096,684 to 21,707,381. The number of cattle rose from 5,733,698 to 6,213,783. The number of sheep increased considerably, 8,401,300 being inspected, against 7,497,738 last year.

The inspection of animals at time of slaughter, with the number of carcasses and parts of carcasses condemned and tanked, is shown in the next table. The number of condemnations for trichinosis is given under the head of "Microscopic inspection of pork:"

Postmortem inspections for the fiscal year 1903.

Kind of animal.	Number of inspections.			Carcasses condemned.			Parts of carcasses condemned.
	For official abattoirs.	On animals rejected in stock yards.	Total.	For official abattoirs.	Animals rejected in stock yards.	Total.	
Cattle	6,134,410	31,480	6,165,890	11,619	2,986	14,605	3,090
Sheep	8,585,960	12,215	8,598,175	10,570	4,663	15,233	106
Calves	668,855	1,318	670,173	1,257	372	1,629	76
Hogs	21,793,738	33,309	21,827,047	41,841	5,153	46,994	61,208
Horses	344	....	344	11	....	11	....
Total	37,183,307	78,322	37,261,629	65,298	13,174	78,472	64,480

In addition to the carcasses condemned as above, and to those condemned for trichinosis, the number tanked for other reasons is given in the table below. These were the carcasses of animals that had died in the cars or pens at abattoirs, or that died after inspection in the stock yards, or that were killed by city inspectors:

Manner of death.	Cattle.	Sheep.	Calves.	Hogs.	Horses.	Total.
Died in yards	450	899	92	1,521	....	2,962
Killed in yards	244	45	5	19,726	....	20,020
Died at abattoirs	550	1,928	246	10,020	....	12,744
Total	1,244	2,872	343	31,267	....	35,726

The total number of carcasses and parts condemned and tanked, with the causes of condemnation, and including the animals found dead and those killed by city inspectors, is shown in the following:

Causes of condemnation of carcasses and parts of carcasses, fiscal year 1903.

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.		Horses.
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.
Actinomycosis	834	837	......	......	5	1	32	44	......
Tuberculosis	8,598	250	10	......	16	......	20,299	52,006	......
Caseous lymphadenitis	......	......	2,567	2	......	......	......	......	......
Cholera and swine plague	......	......	......	......	......	......	19,256	......	......
Texas fever	258	......	......	......	40	......	......	......	......
Echinococcus	......	......	5	2	......	......	12	164	......
Measles	......	......	......	......	......	......	12	......	......
Scabies	......	......	1,267	......	......	......	45	......	......
Eczema	......	......	......	......	......	......	7	......	......
Erysipelas	......	......	......	......	......	......	14	......	......
Cancer	101	......	3	......	1	......	7	......	......
Tumor	5	5	1	......	......	......	347	706	......
Abscess	108	538	107	13	9	5	625	899	......
Pneumonia	162	......	368	......	17	......	746	......	1
Pleurisy	3	......	20	7	2	......	48	14	4
Carditis	......	......	1	......	......	......	......	......	......

Causes of condemnation of carcasses and parts of carcasses, fiscal year 1903—Continued.

Cause of condemnation.	Cattle.		Sheep.		Calves.		Hogs.		Horses.
	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.	Parts.	Carcasses.
Enteritis	31		91		11		240		
Peritonitis	189		78		38		439		
Metritis	22		26		2		130		1
Nephritis	2		11		3		26		
Uremia	4		12		1		15		
Mammitis			1				2	85	
Septicemia	253		209		54		486		2
Pyemia	293		175		25		1,696		1
Gangrene	33		10		10	4	16		
Anemia, emaciation, marasmus	1,931		8,417		78		412		2
Ascites and anasarca	14		32		1		42		
Jaundice	5		407		7		620		
Extreme temperature, various causes	2		57		12		1,069		
Pregnancy	47		40				77		
Recent parturition	48		9				36		
Hernia	4		3		1		3		
Downers, bruised, injured, etc.	1,627	1,460	1,240	82	229	66	235	7,290	
Dead from various causes	1,000		2,827		338		11,541		
Too young			3		1,065				
Killed by city inspectors	244		45		5		19,726		
Asphyxia	31								
Melanosis					1				
Arthritis					1				
Flukes			1						
Edema			1						
Big head			1						
Distoma			28						
Pulmonary apoplexy			6						
Cysticercus tenuicollis			1						
Bladder worm			1						
Lardaceous degeneration			2						
Anthrax			22						
Total	15,849	3,090	18,105	106	1,972	76	78,261	61,208	11

For the purpose of comparison, the number of animals inspected at time of slaughter for abattoirs having inspection, for the fiscal years 1891 to 1903, is given below:

Number of animals inspected at slaughter for abattoirs having inspection, fiscal years 1891 to 1903.

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Horses.	Total.
1891	83,889					83,889
1892	3,167,009	59,089	583,361			3,809,459
1893	3,922,079	92,947	870,512			4,885,538
1894	3,861,594	96,331	1,020,764	7,648,146		12,626,835
1895	3,704,042	116,093	1,428,601	13,616,539		18,865,275
1896	3,985,484	256,905	4,629,796	14,250,191		23,122,376
1897	4,242,216	273,124	5,209,161	16,808,771		26,533,272
1898	4,418,738	244,330	5,496,904	20,893,199		31,053,171
1899	4,382,020	246,184	5,603,096	23,836,943	3,332	34,071,575
1900	4,841,166	315,693	6,119,886	23,336,884	5,559	34,619,188
1901	5,219,149	413,830	6,639,212	24,642,753	1,992	36,916,936
1902	5,559,969	555,836	7,434,878	25,277,107	1,649	38,829,439
1903	6,134,410	668,855	8,585,960	21,793,738	344	37,183,307

The meat-inspection tag or label was placed upon 21,124,318 quarters, 362,689 pieces, and 186 sacks of beef, 8,571,643 carcasses of sheep, 667,259 carcasses of calves, 880,945 carcasses of hogs, and 696,279 sacks of pork.

The meat-inspection stamp was affixed to packages of meat products that had received the ordinary inspection, as follows: 7,520,854 of beef, 59,314 of mutton, 14,601,202 of pork, and 70 of horseflesh—a total of 22,181,440.

The number of cars sealed, containing inspected meat products for shipment to official abattoirs and other places was 67,046.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 30,152. Of beef there were 1,388,633 quarters, 20,422 pieces, 401 bags, and 1,352,291 packages, with a weight of 371,920,737 pounds; of mutton there were 35,394 carcasses and 22,527 packages, weighing 2,729,013 pounds; of pork there were 24,380 carcasses and 506,311 packages, weighing 133,122,610 pounds.

The decrease in the certified exports of beef and pork, noted in the last report, continued, the figures showing a decline from the last year of 45,070,025 pounds of beef, and 55,237,401 pounds of pork. The exports of mutton were nearly two and a half times as much as last year, when there were 1,145,248 pounds certified.

There was one shipment of horseflesh, 70 packages, weighing 28,000 pounds.

The following table shows for several years the amounts of beef,

pork, and mutton for which certificates were issued, not including microscopically examined pork:

Quantities of beef, mutton, and pork for export upon which certificates of ordinary inspection were issued, 1898 to 1903.

Fiscal year.	Beef.	Mutton.	Pork.
	Pounds.	*Pounds.*	*Pounds.*
1898	339,650,091	324,996	244,956,482
1899	360,843,856	525,705	278,696,435
1900	438,138,233	680,897	272,050,663
1901	452,830,373	894,648	231,144,938
1902	416,990,762	1,145,248	188,360,011
1903	371,920,737	2,729,013	133,122,610

The cost of the work of the ordinary meat inspection for the year was $711,546.18.

MICROSCOPIC INSPECTION OF PORK.

The number of carcasses examined was 489,667, classified as follows: Class A (free of all appearances of trichinæ), 477,195, or 97.45 per cent; Class B (containing trichina-like bodies or disintegrating trichinæ), 7,394, or 1.51 per cent; Class C (containing living trichinæ), 5,078, or 1.04 per cent.

There were 5,136 trichinous carcasses disposed of during the year; these weighed 1,093,376 pounds, and about 41 per cent was tanked and the rest made into cooked meat.

The number of certificates issued for microscopically inspected pork products for export was 3,132; the number of packages stamped and exported was 62,779, weighing 19,108,341 pounds. The exports decreased 14,572,888 pounds.

The following shows the exports of pork to countries requiring a certificate of microscopic inspection, from 1892 to 1903:

	Pounds.		Pounds.
1892	22,025,698	1898	120,110,356
1893	8,059,758	1899	108,858,149
1894	18,845,119	1900	55,809,626
1895	39,355,230	1901	35,942,404
1896	21,497,321	1902	33,681,229
1897	42,570,572	1903	19,108,341

The cost of the microscopic inspection was $78,179.63, being an average of 16 cents for each examination, and for each pound exported, 0.41 cent.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

The number of certificates of inspection issued for American cattle exported to Europe was 960. The number of clearances of vessels carrying live stock was 634. The number of sheep exported to Europe

decreased from 211,224 in 1902 to 111,448 this year. The exports of horses fell off very considerably, also, being 3,910 this year, as against 10,967 in 1902. All of the animals shown in the following table were exported to Great Britain, except 1,752 cattle, 832 sheep, and 88 horses to Belgium, and 191 horses to Germany:

Number of inspections, etc., of American and Canadian animals, fiscal year 1903.

Kind of animal.	American.				Canadian.		
	Inspections.	Rejected.	Tagged.	Exported.	Inspected.	Rejected.	Exported.
Cattle	530,874	1,693	301,118	[a]288,365	43,269	36	43,233
Sheep	195,463	67	....	[b]111,448	47,780	51	47,729
Horses	5,172	1	3,996	3,910	120	....	120

[a] 35,437 via Canada. [b] 1,738 via Canada.

There were also inspected for export to other countries, 1,797 cattle, 1,847 sheep, 1 horse, and 12 mules; they were distributed as follows: 1,645 cattle, 1,702 sheep, and 1 horse to Bermuda; 145 sheep to Barbados; 140 cattle to Brazil; 12 cattle and 12 mules to Jamaica.

The number of American and Canadian animals landed alive at the foreign-animal wharves in London, Liverpool, and Glasgow, and inspected by inspectors of this Bureau stationed at these ports, together with the number and percentages lost in transit, is shown in the table following:

Number of animals inspected at time of landing in London, Liverpool, and Glasgow, and lost in transit, fiscal year 1903.

From—	Cattle.			Sheep.			Horses.		
	Landed.	Lost.		Landed.	Lost.		Landed.	Lost.	
	No.	*No.*	*Per ct.*	*No.*	*No.*	*Per ct.*	*No.*	*No.*	*Per ct.*
United States	245,461	249	0.10	104,180	947	0.90	3,423	30	0.87
Canada	43,406	81	.19	48,082	705	1.44	144	2	1.37
Total	88,867	330	.11	152,262	1,652	1.07	3,567	32	.89

INSPECTION OF IMPORTED ANIMALS.

The inspection of animals imported from Mexico is shown in the table following:

Importation of Mexican animals, fiscal year 1903.

Port of entry.	Cattle.	Sheep.	Hogs.	Goats.	Horses.	Mules.	Burros.	Asses.
Eagle Pass, Tex	2,464	....	....	568	8	....	....	....
El Paso, Tex	32,248	....	65	....	12	37	....	....
Nogales, Ariz	14,698	125	40	447	....	....	....	1
San Diego, Cal	2,370	3,994	92	779	59	9	1	2
Total	52,780	4,119	197	1,794	79	46	1	3

There were also inspected animals imported from Mexico, in bond, as follows: At Nogales, 93 cattle in transit to Mexico; at El Paso, 1,036 horses, 7 mules, 14 asses, and 23,968 cattle, and at Eagle Pass, 3,222 cattle, in transit to Canada.

Through ports on the seacoast animals not subject to quarantine were imported as follows:

From—	Horses.	Ponies.	Mules.	Donkeys.	Asses.
Great Britain	1,901	134		1	12
Germany	247				
Belgium	355	1			26
Italy	4	29		4	
India	14				
China	1				
Haiti		1			
Santo Domingo	1				
Trinidad	1	1	1		
Bermuda	17	2			
Cuba	3			1	
Chile		1			
Mexico	5				
Canada	53				
Total	2,602	169	1	6	38

There were also imported 1 goat, 1 cow, 6 sheep, 5 zebras, 6 llamas, 2 elephants, 2 lions, 1 tiger, 1 bear, 1 leopard, 1 monkey, 11 dogs.

A statement of other animals imported will be found under the head of "Quarantines at ports of entry."

CONTROL OF CONTAGIOUS DISEASES.

SOUTHERN CATTLE INSPECTION.

The supervision of the movement of cattle from the district quarantined on account of splenetic fever involved the proper yarding in the quarantine divisions of the various stock yards of 1,620,403 cattle during the quarantine season of 1902. It required 56,608 cars to transport these animals, and all the cars had to be placarded and the waybills and other papers had to state that the cattle were Southern cattle. The number of cars cleaned and disinfected was 66,116.

In Texas 389,525 cattle were inspected and identified as originating outside the quarantine district, and were permitted to be moved to Northern States for grazing.

SCABIES IN SHEEP.

The number of sheep inspected at stock yards, feeding stations, and on farms and ranges amounted in the aggregate to 16,444,370. This number, however, includes sheep reinspected at various places, and therefore does not give the actual number of individual sheep.

The number of sheep dipped under the supervision of inspectors was 2,167,002; of these, 394,636 were dipped twice.

THE WORK OF THE DAIRY DIVISION.

The chief distinction between the work of the Dairy Division during the fiscal year ended June 30, 1903, and that of preceding years has been the additional duty assigned to it in connection with the administration of those parts of the act of Congress approved May 9, 1902, under which certain duties devolve upon the Secretary of Agriculture concerning the manufacture, interstate commerce, and export of renovated butter.

In preparation for this service a code of regulations for the execution of the law stated, and required by its provisions, was formulated by a joint board composed of representatives of the two Executive Departments concerned, and approved by the Secretary of the Treasury and the Secretary of Agriculture. These regulations were published in the form of Bureau of Animal Industry Order No. 94, dated June 21, 1902, and republished, slightly amended, as Bureau of Animal Industry Order No. 98, dated November 1, 1902.

So far as they relate to the Department of Agriculture, these regulations are intended for the proper enforcement of the provisions and manifest purposes of section 5 of the said act; they contemplate the sanitary inspection of materials, factories, and processes necessary to insure a sound and wholesome product and methods of packing and marking the same which will preserve its commercial identity and make renovated butter known to all buyers as distinct from other kinds or grades of butter. The marks, labels, or brands required for this commodity are the same when the subject of interstate commerce as when exported from the United States.

Various questions have arisen regarding the interpretation and application of these regulations, and for a time there were strenuous efforts made to have them modified. The Secretary of Agriculture, after hearing the various parties concerned and giving full consideration to the subject, decided that there was no sufficient cause for change. The regulations promulgated in November are still in force, and during the last few months there have been no remonstrances or complaints regarding them.

The work of inspecting renovated-butter factories and markets was at first assigned to the three inspectors of dairy exports already employed and two additional inspectors temporarily appointed for the purpose. It was soon found necessary to double this force, and through the instrumentality of the United States Civil Service Commission a special examination was held in December and a corps of ten dairy inspectors appointed, who were regularly on duty during the latter part of the year. One of these is a temporary appoint-

ment. Four of these inspectors are not yet on duty during the whole of any one month, but the work is increasing and all will soon be needed for practically their entire time. They may continue, as now, to include in their duty such supervision as is necessary of dairy exports in general and the conduct of special dairy investigations.

These dairy inspectors constitute a body of men of rare experience in the production, testing, grading, and handling of dairy products of all kinds, the detection of dairy adulterations, imitations, and frauds, and the execution of dairy laws. It would be difficult to find, if needed, an equal number of men of like expert knowledge, skill, and tried judgment.

During the fiscal year 1902–03 these inspectors, assisted to some extent by the chief and assistant chief of the Dairy Division, have repeatedly inspected 82 renovated-butter factories and have visited 300 cities and towns in 45 States, Territories, and the District of Columbia for the purpose of ascertaining the extent to which renovated butter is distributed in domestic markets and the conditions under which this special commodity is sold at wholesale and retail.

Factories to the number of 82 have been licensed and bonded by the Treasury Department for the manufacture of renovated butter. They were located in 17 States and the District of Columbia. Of these factories 28 have been in operation throughout the fiscal year, 23 commenced operations subsequent to July, 1902, and continued until the end of June, 1903, and 31 ceased manufacturing before the close of the year.

The total quantity of renovated butter made at licensed factories during the fiscal year 1902–03 was 54,656,800 pounds. Of this amount about 500,000 pounds remained in possession of the manufacturers, taxes unpaid, at the close of the year. A close estimate of the like manufacture for the fiscal year 1901–02, being the next before the date when a tax was placed upon the product, and based largely upon factory records, shows the output to have been about 50,000,000 pounds, made at 55 factories.

For the purpose of closer comparison of the product of the two fiscal years mentioned 10 factories have been selected, located in 6 States, from which accurate records of the output of both years have been obtained; all were in operation twelve months in each year. The totals are as follows: Ten factories produced in 1901–02, 17,082,274 pounds; the same produced in 1902–03, 18,609,718 pounds.

The business thus increased 9 per cent in volume. It is shown by this comparison, as well as by other facts of record, that the law in question has not been obstructive and has proved no hindrance to manufacturers who have cheerfully acquiesced in its provisions and energetically conducted their business.

During this first year of the operation of the law officers of the

Department have inspected 144 different lots of renovated butter about to be exported to foreign countries, comprising 23,820 packages and approximately 1,312,000 pounds.

The principal facts developed by the market inspections follow: The retail trade in renovated butter is comparatively small, and in many places is wholly suspended during the summer months, when creamery butter is comparatively cheap and when supplies are at the maximum of low-priced fresh dairy or country butter. In some places, notably in the Pacific and Mountain States and some of the Southern States, renovated butter is still almost unknown, even by merchants. In large sections of the country, especially the New England and Middle States and the Central West, this kind of butter is nearly always to be found in market at least half the year, and competes directly with all classes of butter except the best creamery. Wholesale dealers and large jobbers and distributors handle it, as a rule, in the original packages as received from manufacturers, with all stamps, brands, and identifying marks intact. Some jobbers are known to disregard the purpose of the law and the cautions given in labels and regulations by removing renovated butter from the original packages, destroying all marks, and selling it without making known its special character and grade. This is believed to be an illegal practice, and a suit has been instituted in the United States court for the district of Connecticut to secure a judicial determination of the question. Twelve States have special laws regulating the sale of renovated butter, and in most of them these laws are well enforced and the commercial identity of the article is preserved and made known to the purchasing consumers. In a few States where the laws are not executed, and in others which have none, retail dealers in renovated butter may be divided into two classes, apparently about equal in number. The one class practices honesty in trade, selling renovated butter under its right name, with all identifying marks preserved; the other class endeavors to facilitate trade or increase profits by concealing the identity of the taxed article and disposing of it simply as "butter" or under false names and marks at the highest possible price. Millions of pounds are thus unquestionably still retailed as creamery butter and at corresponding prices, as was very generally done prior to the enactment of this law.

The quality of renovated butter has been much improved. The difference between the average quality of the product during the past year and the same commodity a few years ago is very marked. This is due to improved machinery and processes, and also to the better average quality and condition of the packing stock or raw material used. The development of the business, with wider distribution and better organization and natural competition among manufacturers, have prevented the former accumulations of country butter at remote points, kept the stock comparatively well cleared up, and resulted in

some improvement in packages, packing, and transportation to factories or to markets. The average character and condition of the material used in this manufacture is therefore decidedly better than formerly. Occasionally a lot of packing stock is found in such a condition of filth or putrefaction as to necessitate condemnation. In two instances material of this character has been manufactured before being seen, so the finished product had to be condemned as unfit for food. In such cases inspectors have required that material and product be disposed of as grease. But these instances are very exceptional. There is still opportunity for great improvement in materials, in the manner of handling the same, and in the finished product, but, as a rule, manufacturers are endeavoring to improve conditions at all points and are ambitious to win a reputation for producing an article of high quality.

Renovated butter reaches market in various grades as to quality, the same as other butters. There are products good, bad, and indifferent from different factories and sometimes from the same factory. Renovated butter generally ranks as the equal of creamery butter of "seconds" grade in quality and price, and sometimes it is as good as creamery "firsts." Recently, when creamery "extras" (highest grade) were selling in New York at 20 cents wholesale, the best grade of renovated commanded 18 cents. One case is known where 700 packages of creamery butter of "firsts" grade were sold by the makers for 16½ cents per pound, when the same manufacturers were readily selling their best renovated product at 17 cents. The best renovated goods compare favorably with the general run of best dairy or farm butter in the market, although the latter usually sells a shade higher. The position of renovated butter in the general market is becoming more and more fixed. The required markings serve as a guaranty of purity and to its standing. They are seldom objected to except by those who want to dispose of this article as another kind of butter and at a higher price.

It was the evident intent of the law to mark renovated butter so distinctly as to make its character or kind known all the way from the manufacturer to the consumer, but the law fails to fully accomplish this object. Having sufficiently provided for marking or branding the butter itself, its covers and packages, section 5 of the act of May 9, 1902, protects these Government marks only by indirection and reference to other statutes. By reason of this omission or imperfection, some merchants who obtain the article from manufacturers, properly packed and marked, empty the original packages, as already stated, destroy the identifying marks, and repack the commodity in various forms, marked "Creamery butter," or otherwise falsely labeled, or not marked at all, and resell to dealers and consumers without informing these buyers that it is renovated butter. The purpose of the law is

thus defeated. Section 5 should be amended so as to provide specific penalties for destroying or defacing any of the duly authorized marks upon renovated butter and its packages.

The predictions that the law referred to would be detrimental to the interests of makers of country butter of the poorer grades, which goes to make up the bulk of the "packing stock," reducing its price and the consequent income of farmers from this source, have not proved true. Since the law went into effect two attempts have been made to combine manufacturers of renovated butter, who are the chief buyers of packing-stock butter, and fix a low maximum price for the latter; but the efforts have failed through the competition of buyers who needed the material to keep their renovating factories in operation. During part of the season of 1901, and still more during the earlier portion of 1902, a feverish condition of the market led to the payment of abnormally high prices for packing-stock butter to be stored for manufacture later. The prices of these low grades of butter ranged very high for a time, although the farmers who first sold it received but a small part of this temporary advance. The whole movement was exceptional and entirely independent of the law of Congress and its effects. Since the operations of the law have become generally understood and its effects appreciated the market for the new material has been comparatively steady and prices for packing stock have been relatively as high as two and three years ago and higher than for several years just preceding the introduction of the renovating process.

In the administration of that portion of the law regarding renovated butter which is assigned to the Department of Agriculture during this first year after going into effect many allowances have been made for errors and omissions in observing the regulations, due to the novelty of the subject, misunderstandings, and inadvertence, and even in cases of indifference and negligence. It is believed that after one full year's experience in operating factories under the law, with repeated visits and explanations from inspectors, in addition to printed instructions and special correspondence, it is time more strictly to enforce the reasonable regulations and time to make the sanitary inspections more effective.

The Dairy Division has again assisted in procuring butter for the use of the United States Navy by perfecting specifications and supervising the execution of contracts. Dairy inspectors have examined and passed upon 700,000 pounds of butter included in naval contracts during the year, and the Navy Department has acknowledged the service rendered and its satisfactory results. A much less quantity of butter has been inspected for the Army, upon the application of purchasing officers for the Subsistence Department.

By the cooperation of this division a "national educational test of creamery butter" was conducted covering six months and embracing

monthly samples of the product of about 500 creameries located in 19 different States. Incidentally determinations were made of the moisture content of 730 packages of butter from 400 representative creameries in 18 States, with the gratifying result of showing that the average creamery butter of the country appears to contain less than 12 per cent of water.

A cooperative experiment in the cold-curing of cheese upon a commercial scale was carried on in conjunction with the agricultural experiment stations of Wisconsin and New York. The report of this work is now in press.

The work of the Dairy Division during the fiscal year 1903–04 will embrace, in large measure, a continuation of that of previous years and also include several material additions. The condition of the dairy industry of the United States will be studied in all its aspects, with a view to determining the most favorable opportunities and methods for progress and improvement and assisting in their accomplishment. The dairying of other countries will also be observed, productive conditions noted, the demands of consumption and of all foreign markets watched, and such action taken as is possible in the interest of extending foreign trade in the dairy products of this country. Relations will be maintained with State dairy officials with a view to cooperation in the enforcement of law; also with the voluntary organizations of dairymen and the dairy schools in numerous States, in order to be informed of their proceedings and to cooperate so far as may be advisable.

The inspection of renovated-butter factories and markets will continue and be gradually extended and improved for the better administration of section 5 of the act of Congress of May 9, 1902.

This Division will conduct investigations by itself or in cooperation with suitable agencies. An exhaustive study will be made of the conditions and limitations incident to the extension of the dairy industry in the "short-grass country" or "semiarid region" east of the Rocky Mountains. This will include careful consideration of the centrifugal cream separator for hand power or light power and its proper relations to the creamery system of making butter. A series of commercial tests will be conducted to determine the relations between different temperatures and other atmospheric conditions in storage and the maintenance of quality in butter stored for several months. It is also proposed to investigate the manufacture of condensed milk and the action which may be expedient to preserve and promote the reputation of this country for producing this article in a form suited to foreign markets.

In considering the future of the Dairy Division it should be first remarked that after eight years' existence the work in hand and the opportunities for usefulness in extending present lines of effort and

taking up new ones are much greater than can be accomplished by the original organization. The dairy industry is one of the most important and most extensive branches of American agriculture. Four-fifths of all the farms in the country keep cows for milk, seventeen million in number, and another million are reported "not on farms." The annual product of these eighteen million dairy cows has a value of about $600,000,000. The opportunities for improvement are manifest at many points. If the average cost of maintaining a cow could be lessened by intelligent economy, or the average dairy product slightly increased in quantity by rational treatment, or the average quality of dairy products raised a little by improved methods of practice, the aggregate additional profit would be very great. For example, one-third of all the butter produced in the United States is made in creameries and two-thirds on farms. The former, by reason of higher average quality, has a value of at least 3 cents per pound greater than the latter. If one-half the butter now made on farms could be made in creameries or in any way to make it as good as average creamery butter, the increased income to this third (only) of our butter producers would amount to $15,000,000 a year. Again, if the average municipal milk supply could be but slightly improved in quality and sanitary condition and the service correspondingly improved, the gain in the comfort and health of millions of people would be beyond measurement by dollars. Such improvements are entirely practicable and in large measure comparatively easy of accomplishment. In the accomplishment of them the Dairy Division strives to assist and sometimes to lead, doing those parts of the work which are impossible to individuals or even associations of individuals.

THE ANGORA GOAT INDUSTRY.

The great interest which has become widespread in the Angora goat industry during the past three years has not abated in the least, and this Bureau has done everything possible to assist the Angora goat raisers to place this industry upon a permanent basis. The correspondence concerning this feature of the work has been cared for in the editorial office, and the editor, Mr. George Fayette Thompson, visited the annual show at Kansas City in October and addressed the breeders along lines favorable to better animals and better mohair. There is a constant demand for the literature on this subject published by the Bureau, and there is every evidence that the industry is rapidly becoming established in all parts of the country.

The disease, which has been given the name of "takosis," referred to in my last report, seems to have about run its course, and it is hoped that it will not reappear. In the meantime, purchasers are advised to select animals carefully in order not to introduce the disease into flocks where it has not already existed.

ANIMAL HUSBANDRY.

The expert in animal husbandry, Mr. George M. Rommel, has prepared an extensive bulletin on the hog industry in the United States, and it is now ready for the printer. He has also devoted considerable time to an investigation of alleged irregularities of a certain breeders' association, and his report on this matter has been placed in the hands of the Secretary. These investigations have shown the necessity of more careful supervision by this Department over the importation of animals for breeding purposes and more careful scrutiny of the registers accepted as evidence of the pure breeding of animals admitted free of duty.

REPORT OF THE WORK AGAINST SHEEP SCAB IN 1903.

By C. O. GOODPASTURE,
Of the Inspection Division, Bureau of Animal Industry.

The efforts of this Bureau toward the eradication of scabies in sheep were carried on with increased vigor during the year 1903, and the figures relating to this work will bear out the statement that, while it was much more extensive than in any previous year, it was likewise more satisfactory to all concerned.

The following exhibit shows at a glance the growth of the work during the past three years:

Comparative exhibit of inspections.

Year.	Total inspections.	Total infected sheep.	Percentage of infection.
1901	10,103,806	758,517	7.51
1902	15,327,766	1,366,007	8.91
1903	33,647,563	3,021,190	8.98

The large increase in total inspections as shown above is due in part to the normal increase in the movement of live stock and of the facilities for the inspection of sheep, but more largely to the fact that in previous years some of the regular stations failed to report the inspection of sheep found free from scab which were sold for slaughter at local abattoirs. These discrepancies, affecting only the States in which the principal packing centers are located, will be seen at a glance by comparing the statement on page 45, showing the inspections by States in 1903, with the similar statement published last year.

It is noted that a slightly larger percentage of sheep inspected were reported to be infected with scabies than were so reported in previous years, but this may be understood when it is stated that the principal work was done in Western States, where the disease is most prevalent and where sheep are run in large bands (1,000 to 3,000 head), and that under the regulations of the Bureau (B. A. I. Order 108) when scab is found at all in a band the entire lot is reported and recorded as infected sheep. It is for this reason that in the statement above referred to on page 45, showing in detail the year's inspections, it appears that two-thirds of all the infected sheep were found in the State of Wyo-

ming, and that nearly one-third of all the sheep inspected in that State were reported to be scabby.

From the following exhibit it will be seen that the work of dipping has more than kept pace with that of inspecting, for whereas in 1902 the number of dippings was only 13.8 per cent of the total inspections, the number of dippings in 1903 was 24.7 per cent of the total number of inspections. It will also be seen that while only 15 per cent of the sheep dipped in 1902 were submitted to a second dipping, 29 per cent were redipped in 1903.

Comparative exhibit of dippings.

Year.	Dippings of infected sheep.	Dippings of free and exposed sheep.	Total.	Redippings.	Total.
	Number.	*Number.*	*Number.*	*Number.*	*Number.*
1900	127,521	806,910	934,431	....	934,431
1901	292,569	594,076	886,645	....	886,645
1902	880,847	959,461	1,840,308	275,921	2,116,229
1903	2,311,914	4,124,778	6,436,692	1,869,703	8,306,395

Although there were nearly four times as many dippings under the supervision of representatives of the Bureau in 1903 as there were in 1902, the number of men employed in the field was increased only about 50 per cent, the number in 1902 being about 54 as against 80 in 1903. This result was rendered possible only by the fact before alluded to, that most of the work was done on the large Western ranges.

The following exhibit shows in a most gratifying way that the work of these men and the methods of the Bureau now in vogue are accomplishing the desired result, and it is evident that, with the continued cooperation of the sheep owners, transportation companies, and stock-yards companies, it is only a question of a few more years when the fight against sheep scab will be successfully completed.

Comparative exhibit of the results of dipping.

[Compiled from letters received from owners of the sheep dipped.]

Year.	Whole number of dippings.	Number reported upon.	Per cent.	Number letters received.	Per cent—	
					Effective.	Ineffective.
1900	934,431	515,112	55.1	753	86	14
1901	886,645	356,359	40.2	536	91.8	8.2
1902	1,840,308	790,769	43	957	92	8
1903	6,436,692	3,950,161	61.4	3,558	98.5	1.5

It will be noted that 3,558 reports have been received from owners regarding the results of the dipping done in 1903. These reports cover nearly 4,000,000 dippings, being 61.4 per cent of the entire number for the year; and, although three-fourths of this work was done in

Western States, where the disease is most prevalent, and where, in many instances, the dipped sheep were immediately exposed to the disease, either by contact with scabby sheep or by trailing over infected ranges or using infected bed grounds, the general results of the dipping, based upon this large number of reports from all parts of the country, are that 98.5 per cent of the work was effective and but 1.5 per cent ineffective.

In calling for these reports the owners were invited to offer remarks or suggestions relating to the work, and it is interesting, in going over their replies, to note that almost without exception these remarks are of an approving nature and the suggestions such as look to an extension and improvement of the work. The following are but a few of the many encouraging statements received. These are from men who have large sheep interests, and are therefore indicative of the sentiment of the people most concerned.

John S. Hacking, of Vernal, Utah, says: "There was not one scabby sheep this fall (1903) where there were 100 a year ago."

C. C. Burkhalter, of Opal, Wyo., says: "The sheep in this locality are freer from scab this fall (1903) than at any previous time in the last eleven years."

W. M. Robb, of Winchester, Ky., says: "I have handled about 15,000 sheep and lambs since May, 1903, and am glad to tell you that I do not find one-tenth as many flocks affected as I did in 1902."

M. Lill & Sons, of Andale, Kans., write: "We thank the Bureau for what it has done for us. We did not know how to treat our sheep until you taught us."

The Standard Meat and Live Stock Company, of Denver, reports through its president regarding conditions on the Wyoming ranges, as follows: "We are proud of the work the Government did for us last year (1903). One year ago 90 per cent of all the herds were scabby. Now there are not 5 per cent scabby."

Ed. Benedict, of Arthur, Iowa, says: "I bought a good many sheep in Omaha before the Government took charge of the dipping and had a great deal of trouble with the scab; have bought just as many since and have had no scab."

It is further noted in reading these letters that the answers to the questions relating to the efficiency of the dipping are, as a rule, made with deliberation and care, and frequently after a close inspection of the sheep; and this fact, taken in connection with the further fact that cases in which scab developed within sixty days after the dipping were counted as ineffective, renders the statistics decidedly conservative.

The following summary shows that, as a rule, the dipping of sheep at private plants is more effective than that done at public dipping stations, and this is also quite apparent in the statement on page 48, showing in detail the efficacy of the work done in 1903:

Distribution of the dippings reported upon in 1903.

Where dipped.	Number of dippings.	Effective.		Ineffective.	
		Number.	*Per cent.*	*Number.*	*Per cent.*
At regular stations	942,840	924,583	98.1	18,257	1.9
At private plants	3,007,321	2,964,977	98.6	42,344	1.4
Total	3,950,161	3,889,560	98.5	60,601	1.5

The percentage of efficacy of the different dipping preparations recognized by the Bureau and used the past four years is shown in the following table:

Percentage of efficacy of dips.

Year.	Nicotine and sulphur.		Tobacco extract and sulphur.		Lime and sulphur.		All dips.	
	Effective.	Ineffective.	Effective.	Ineffective.	Effective.	Ineffective.	Effective.	Ineffective.
1900	88	12	89	11	74	26	86	14
1901	92.5	7.5	87	13	96	4	91.8	8.2
1902	81.7	18.3	94.3	5.7	91.3	8.7	92	8
1903	98	2	98.4	1.6	98.5	1.5	98.5	1.5
Average for four years	90	10	92.2	7.8	90	10	92.1	7.9
Average last three years	90.7	9.3	93.2	6.8	95.3	4.7	94.1	5.9

As will be seen from the above exhibit, tobacco extract and sulphur has the highest average percentage of efficacy for the four years, but this is doubtless the result of the improper mixing of the lime-and-sulphur dip during the first year owing to inexperience in its preparation. This is evidenced by the record for 1903, in which lime and sulphur breaks the record with a percentage of efficacy of 98.5, and also by the average for the last three years, in which it goes to 95.3 per cent, being more than two points above tobacco extract and sulphur. While it is thus evident that lime and sulphur, prepared strictly according to directions, is the most efficacious dip recognized by the Bureau, it is also evident that the results obtained with tobacco extract and sulphur are highly satisfactory. The fact that tobacco extract and sulphur is the most easily prepared is doubtless the reason that, as shown in the following exhibit, over one-half of all the dippings during the past four years were with that preparation.

Number of dippings in different preparations for four years.

Year.	Nicotine and sulphur.	Tobacco extract and sulphur.	Lime and sulphur.	Total.
1900	213,962	204,970	96,180	515,112
1901	157,587	109,025	89,747	356,359
1902	55,833	362,935	372,001	790,769
1903	161,175	2,207,430	1,581,556	3,950,161
Total	588,557	2,884,360	2,139,484	5,612,401

During the year about 21,000 documents relating to sheep scab were mailed to sheep owners and others interested in the business. In addition, 430 letters were sent to owners and shippers of scabby sheep, notifying them that it is a violation of the law and the regulations of the Department to move scabby sheep from one State to another and soliciting their cooperation in eradicating the disease.

It will be remembered that in 1902 the principal work was done in Utah, and the following comparative statement shows in a most striking way the favorable results of that campaign against scab:

Comparative statement of work done in Utah, 1902 and 1903.

	1903.	1902.
Total number of inspections	882,002	919,525
Total number infected	176,950	494,120
Percentage of infection	20.1	53.7
Dippings of infected sheep	155,381	430,556
Dippings of free and exposed sheep	263,792	15,916
Total dippings	419,173	446,472
Number reported upon	256,254	159,891
Percentage effective	95	87.9
Percentage ineffective	5	12.1

In view of the fact shown above—that so many (263,792) free and exposed sheep were dipped in 1903—it is confidently expected that the percentage of infection, which was reduced from 53.7 in 1902 to 20.1 in 1903, will again be perceptibly lowered in 1904; and it is further expected that when the season of 1904 is over it will be seen that the work done in Wyoming in 1903 has accomplished similar results.

The following statements show, in detail, the figures covering the year's work, as already presented in the condensed exhibits:

Summary of inspections of sheep for scabies, January 1 to December 31, 1903.

State or Territory.	Infected.	Exposed.	Free.	Total.
	Number.	*Number.*	*Number.*	*Number.*
Arizona	8,711		200,128	208,839
Arkansas	8		8,100	8,108
California	52,052	45,458	302,860	400,370
Colorado	96,287	59,733	1,185,430	1,341,450
Idaho	20,245	37,265	1,421,963	1,479,473
Illinois	161,402	837,055	5,705,745	6,704,202
Indiana	964	274	89,161	90,399
Indian Territory	280		323	603
Iowa	6,561	3,701	80,864	91,126
Kansas	24,789		118,932	143,721
Kentucky	135		259,940	260,075
Minnesota	32,220	703	747,796	780,719
Missouri	25,926	274,793	1,639,872	1,940,591
Montana	4,886		1,252,564	1,257,450
Nebraska	66,251	405,784	4,408,316	4,880,351
Nevada	94,267	24,260	475,416	593,943
New Mexico	97,712	43,009	830,194	970,915
New York	3,177	127,111	1,960,565	2,090,953
North Dakota	705	200	192,910	193,815
Ohio	4,136	37,876	379,731	421,743
Oklahoma			9,546	9,546

Summary of inspections of sheep for scabies, January 1 to December 31, 1903.—Cont'd.

State or Territory.	Infected.	Exposed.	Free.	Total.
	Number.	*Number.*	*Number.*	*Number.*
Oregon	17,654	31,884	872,498	922,036
Pennsylvania	61	4,039	509,320	513,420
South Dakota	1,425	3,520	104,427	109,372
Texas	16,409	6,123	353,336	375,868
Utah	176,950	382,582	322,470	882,002
Washington	8,807	1,350	201,187	211,344
Wisconsin	8,686	280	144,964	153,830
Wyoming	2,090,484	2,119,229	2,401,586	6,611,299
Total	3,021,190	4,446,229	26,180,144	33,647,563

Statement showing number of scabby sheep received at regular stations, four years, to December 31, 1903.

[NOTE.—B. A. I. Order 108, issued April 3, 1903, made more stringent the regulations under which scabby and exposed sheep are transported, and as a direct result it may be stated that 55.3 per cent of all the scabby sheep received at public stock yards during the year, as shown below, were received before this order was issued. It should also be remembered that a large percentage of these were not interstate shipments, and that many others were shipped from small stations where no inspection is maintained.]

Station.	1900.	1901.	1902.	1903.
	Number.	*Number.*	*Number.*	*Number.*
Buffalo	1,846	1,647	1,170	3,177
Chicago	38,573	74,708	44,170	33,284
Cincinnati	2,189	5,518	2,624	3,426
Cleveland	....	....	....	634
Denver	....	....	....	1,301
Fort Worth	....	....	....	414
Indianapolis	174	600	342	964
Kansas City	49,089	38,109	17,030	11,288
Louisville	....	....	....	135
National Stock Yards	16,638	1,114	1,217	3,380
Pittsburg	....	571	....	61
Portland, Oreg	1,151	2,662	1,097	1,284
Seattle	....	447	3,009	7,957
Sioux City	286	2,034	1,599	734
South Omaha	52,026	28,896	32,785	27,954
South St. Joseph	12,125	5,806	4,324	13,204
South St. Paul	472	4,688	4,140	10,933
Total	174,569	166,800	113,507	120,130

Summary of dippings of sheep for scabies, January 1 to December 31, 1903.

State or Territory.	First dipping.				Second dipping.	Total dippings.
	Infected.	Exposed.	Free.	Total.		
	Number.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
Arizona	4,010			4,010		4,010
California	40,938	43,533		84,471	38,864	123,335
Colorado	35,469	9,470	66,470	111,409	2,392	113,801
Idaho	11,442	20,970		32,412	11,256	43,668
Illinois	43,539	692,203	14,182	749,924	20,098	770,022
Indiana	618			618		618
Iowa	130	3,701	1,402	5,233		5,233
Kansas	17,573			17,573		17,573
Minnesota	30,014	412	4,586	35,012	14,657	49,669
Missouri	6,055	243,095	28,861	278,011	3,797	281,808
Montana	4,780			4,780		4,780
Nebraska	18,070	122,444	527,183	667,697	13,427	681,124
Nevada	69,984	17,760		87,744	27,508	115,252
New Mexico	35,227	26,876		62,103	29,308	91,411
New York		4,258	6,527	10,785		10,785
North Dakota	205			205		205
Ohio	223	7,310	4,090	11,623		11,623
Oregon	13,870	17,413		31,283	13,870	45,153
South Dakota	625	90		715		715
Texas	6,000	247		6,247	4,892	11,139
Utah	155,381	262,892	900	419,173	110,772	529,945
Washington	1,352	1,350		2,702	840	3,542
Wisconsin	2,469	280		2,749	5,975	8,724
Wyoming	1,813,940	1,996,026	247	3,810,213	1,572,047	5,382,260
Total	2,311,914	3,470,330	654,448	6,436,692	1,869,703	8,306,395

Statement showing the number of dippings and the kind of dip used at regular stations, January 1 to December 31, 1903.

Station.	Kind of dip used.	Infected.	Exposed.	Free.	Total.	Second dippings.
		Number.	*Number.*	*Number.*	*Number.*	*Number.*
Buffalo	Lime and sulphur		4,258	6,527	10,785	
Chicago	Tobacco extract and sulphur.		668,628	6,732	675,360	
Cincinnati	Nicotine and sulphur	223	7,310	4,090	11,623	
Denver	Lime and sulphur		1,857	62,700	64,557	
Fort Worth	do		247		247	
Kansas City	do	4,411	191,435	24,184	220,030	3,780
Indianapolis	Tobacco extract and sulphur.	618			618	
National Stock Yards.	Nicotine and sulphur		23,344	955	24,299	
Portland, Oreg	Lime and sulphur		45		45	
Seattle	do	840			840	840
Sioux City	Nicotine and sulphur		1,101	1,402	2,503	
South Omaha	Tobacco extract and sulphur.	4,649	72,316	527,183	604,148	240
South St. Joseph	Lime and sulphur	1,644	50,105	3,174	54,923	2,151
South St. Paul	Tobacco extract and sulphur.	8,791	412	4,586	13,789	14,657
Total by dips	Nicotine and sulphur	223	31,755	6,447	38,425	
	Tobacco extract and sulphur.	14,058	741,356	538,501	1,293,915	14,897
	Lime and sulphur	6,895	247,947	96,585	351,427	6,771
Total		21,176	1,021,058	641,533	1,683,767	21,668

Statement showing the efficacy of dips used on sheep exposed to and infected with scab, January 1 to December 31, 1903.

[Compiled from 3,558 replies to circular letter of inquiry sent to owners.]

Station	Nicotine and sulphur.					Tobacco extract and sulphur.					Lime and sulphur.					Total.				Grand total.
	Effective.		Ineffective.		Total.	Effective.		Ineffective.		Total.	Effective.		Ineffective.		Total.	Effective.		Ineffective.		
	No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*No.*	*P. ct.*	*No.*	*P. ct*	*No.*	*No.*	*P. ct.*	*No.*	*P. ct*	*No.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*
Buffalo											5,985	100			5,985	5,985	100			5,985
Chicago						392,536	96.3	15,236	3.7	407,822						392,586	96.3	15,236	3.7	407,822
Cincinnati	6,480	100			6,480											6,480	100			6,480
Kansas City											*[a] 646*	100			*646*	*646*	100			126,938
											125,420	99.3	872	0.7	126,292	125,420	99.3	872	.7	
National Stock Yards	10,624	93.9	685	6.1	11,309											10,624	93.9	685	6.1	11,309
Sioux City	974	100			974	127	100			127						1,101	100			1,101
South Omaha						*1,706*	100			*1,706*						*1,706*	100			347,393
	341	100			341	344,239	99.7	1,107	.3	345,346						344,580	99.7	1,107	.3	
South St. Joseph											*2,151*	100			*2,151*	*2,151*	100			32,619
											30,111	98.8	357	1.2	30,468	30,111	98.8	357	1.2	
South St. Paul						3,193	100			3,193						3,193	100			3,193
Arizona													*2,475*	100	*2,475*			*2,475*	100	2,475
California						*3,900*	100			*3,900*	*19,647*	100			*19,647*	*23,547*	100			56,816
	29,400	100			29,400						3,869	100			3,869	33,269	100			
Colorado						*10,870*	100			*10,870*	*8,539*	100			*8,539*	*19,409*	100			65,937
											46,528	100			46,528	46,528	100			
Idaho											*15,250*	100			*15,250*	*15,250*	100			18,410
											3,160	100			3,160	3,160	100			
Illinois (outside Chicago and National Stock Yards)						*12,456*	100			*12,456*						*12,456*	100			19,182
						6,726	100			6,726						6,726	100			
Kansas (Andale)											*1,700*	100			*1,700*	*1,700*	100			1,700
Minnesota (outside of South St. Paul)						*10,010*	89	*1,232*	11	*11,242*						*10,010*	89	*1,232*	11	11,242

Nebraska (outside of South Omaha)	....	....	....	....	....	*11,600*	100	....	....	*11,600*	*1,640*	100	....	....	*1,640*	*13,240*	100	....	....	34,733
	27	100	....	....	27	4,813	100	....	....	4,813	16,653	100	....	....	16,653	21,493	100	....	....	
Nevada	....	....	....	....	....	....	....	....	....	....	*7,271*	100	....	....	*7,271*	*7,271*	100	....	....	14,071
	....	....	....	....	....	....	....	....	....	....	6,800	100	....	....	6,800	6,800	100	....	....	
New Mexico	....	....	....	....	....	*2,501*	100	....	....	*2,501*	*13,300*	100	....	....	13,300	*15,801*	100	....	....	42,677
	....	....	....	....	....	1,167	100	....	....	1,167	25,709	100	....	....	25,709	26,876	100	....	....	
Oregon	....	....	....	....	....	*2,370*	100	....	....	*2,370*	*4,470*	100	....	....	*4,470*	*6,840*	100	....	....	20,633
	....	....	....	....	....	1,343	100	....	....	1,343	12,450	100	....	....	12,450	13,793	100	....	....	
Texas	....	....	....	....	....	....	....	....	....	....	*2,200*	100	....	....	*2,200*	*2,200*	100	....	....	2,200
Utah	*2,600*	100	....	....	*2,600*	*7,675*	100	....	....	*7,675*	*103,637*	89	*12,811*	11	*116,448*	*113,912*	89.9	*12,811*	10.1	256,254
	....	....	....	....	....	8,629	100	....	....	8,629	120,902	100	....	....	120,902	129,531	100	....	....	
Wisconsin	....	....	....	....	....	280	100	....	....	280	....	....	....	....	....	280	100	....	....	280
Wyoming	*44,679*	100	....	....	*44,679*	*628,188*	97.7	*14,509*	2.3	*642,697*	*576,034*	99.2	*4,586*	.8	*580,620*	*1,248,901*	98.5	*19,095*	1.5	2,460,711
	62,821	96.1	2,544	3.9	65,365	718,680	99.7	2,287	.3	720,967	404,483	99.5	1,900	.5	406,383	1,185,984	99.4	6,731	.6	
Total infected	*47,279*	100	....	....	*47,279*	*691,276*	97.8	*15,741*	2.2	*707,017*	*756,485*	97.4	*19,872*	2.6	*776,357*	*1,495,040*	97.7	*35,613*	2.3	*1,530,653*
Total exposed	110,667	97.2	3,229	2.8	113,896	1,481,783	98.8	18,630	1.2	1,500,413	802,070	99.6	3,129	.4	805,199	2,394,520	99	24,988	1	2,419,508
Grand total	157,946	98	3,229	2	161,175	2,173,059	98.4	34,371	1.6	2,207,430	1,558,555	98.5	23,001	1.5	1,581,556	3,889,560	98.5	60,601	1.5	3,950,161

a Infected sheep are shown in italic figures.

Statement showing efficacy of dips used on sheep exposed to and infected with scab for the calendar years 1900, 1901, 1902, and 1903.

[Compiled from replies to circular letter of inquiry sent to owners.]

Station.	Year.	Nicotine and sulphur.				Tobacco extract and sulphur.				Lime and sulphur.				Total.				Grand total.
		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		
		Number.	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number*	*Per ct.*	*Number.*	*Per ct.*	*Number.*
Buffalo	1900									6,027	90	639	10	6,027	90	639	10	6,666
	1901					2,401	100			11,201	98	220	2	13,602	98.4	220	1.6	13,822
	1902									6,988	100			6,988	100			6,988
	1903									5,985	100			5,985	100			5,985
Chicago	1900	170,952	92	14,075	8									170,952	92	14,075	8	185,027
	1901	116,744	92	10,141	8									116,744	92	10,141	8	126,885
	1902	35,581	81.7	7,995	18.3	90,782	83.9	17,452	16.1					126,363	83.2	25,447	16.8	151,810
	1903					392,586	96.3	15,236	3.7					392,586	96.3	15,236	3.7	407,822
Cincinnati	1900					8,613	100							8,613	100			8,613
	1901					3,496	97.7	84	2.3					3,496	97.7	84	2.3	3,580
	1902					5,230	81.8	1,162	18.2					5,230	81.8	1,162	18.2	6,392
	1903	6,480	100											6,480	100			6,480
Kansas City	1900	7,036	64	4,020	36	23,037	72	8,783	28	31,372	67	15,421	33	61,445	69	28,224	31	89,669
	1901	1,121	100			1,407	100			24,441	92.1	2,080	7.9	26,969	92.8	2,080	7.2	29,049
	1902	3,364	100			4,368	100			142,928	99	1,511	1	150,660	99	1,511	1	152,171
	1903									126,066	99.3	872	.7	126,066	99.3	872	.7	126,938
Louisville	1900					1,737	100							1,737	100			1,737
	1901					282	69	130	31					282	69	130	31	412
	1902																	
	1903																	
National Stock Yards	1900	6,036	74	2,080	26									6,036	74	2,080	26	8,116
	1901	10,164	92	880	8									10,164	92	880	8	11,044
	1902	1,150	100											1,150	100			1,150
	1903	10,624	93.9	685	6.1									10,624	93.9	685	6.1	11,309
Sioux City	1900					11,365	100							11,365	100			11,365
	1901					85	100							85	100			85
	1902	222	100											222	100			222
	1903	974	100			127	100							1,101	100			1,101

South Omaha	1900					136,214	93	9,704	7	15,332	83	3,105	17	151,546	92	12,809	8	164,355
	1901					85,581	86	13,922	14					85,581	86	13,922	14	99,503
	1902					226,968	99.2	1,805	.8					226,968	99.2	1,805	.8	228,773
	1903	341	100			345,945	99.7	1,107	.3					346,286	99.7	1,107	.3	347,393
South St. Joseph	1900	6,183	64	3,480	36									6,183	64	3,480	36	9,663
	1901	787	51.2	750	48.8	467	73	170	27					1,254	57.7	920	42.3	2,174
	1902	4,809	100							12,496	100			17,305	100			17,305
	1903									32,262	98.9	357	1.1	32,262	98.9	357	1.1	32,619
South St. Paul	1900	100	100			1,695	93	125	7					1,795	93	125	7	1,920
	1901					1,000	100							1,000	100			1,000
	1902	512	100			2,624	91.5	244	8.5					3,136	92.8	244	7.2	3,380
	1903					3,193	100							3,193	100			3,193
Arizona	1900																	
	1901											115	100			115	100	115
	1902																	
	1903											2,475	100			2,475	100	2,475
California	1900																	
	1901																	
	1902									3,350	33.1	6,768	66.9	3,350	33.1	6,768	66.9	10,118
	1903	29,400	100			3,900	100			23,516	100			56,816	100			56,816
Colorado	1900																	
	1901																	
	1902					4,380	100			5,075	100			9,455	100			9,455
	1903					10,870	100			55,067	100			65,937	100			65,937
Idaho	1900																	
	1901																	
	1902									410	100			410	100			410
	1903									18,410	100			18,410	100			18,410
Illinois (outside Chicago and National Stock Yards)	1900																	
	1901											900	100			900	100	900
	1902																	
	1903					19,182	100							19,182	100			19,182
Kansas (outside Kansas City)	1900																	
	1901																	
	1902									599	100			599	100			599
	1903									1,700	100			1,700	100			1,700

Statement showing efficacy of dips used on sheep exposed to and infected with scab for the calendar years 1900, 1901, 1902, and 1903—Continued.

Station.	Year.	Nicotine and sulphur.				Tobacco extract and sulphur.				Lime and sulphur.				Total.				Grand total.
		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		Effective.		Ineffective.		
		Number.	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*	*Per ct.*	*Number.*
Minnesota (outside South St. Paul)	1900																	
	1901																	
	1902																	
	1903					10,010	89	1,232	11					10,010	89	1,232	11	11,242
Nebraska (outside South Omaha)	1900					700	18.9	2,997	81.1	5,296	66.1	2,718	33.9	5,996	51.2	5,715	48.8	11,711
	1901									10,000	100			10,000	100			10,000
	1902					2,410	100			26	100			2,436	100			2,436
	1903	27	100			16,413	100			18,293	100			34,733	100			34,733
Nevada	1900																	
	1901									17,100	100			17,100	100			17,100
	1902			2,200	100					6,250	56.5	4,815	43.5	6,250	47.1	7,015	52.9	13,265
	1903									14,071	100			14,071	100			14,071
New Mexico	1900									10,570	100			10,570	100			10,570
	1901									8,690	100			8,690	100			8,690
	1902									217	100			217	100			217
	1903					3,668	100			39,009	100			42,677	100			42,677
Oregon	1900																	
	1901																	
	1902																	
	1903					3,713	100			16,920	100			20,633	100			20,633
Texas	1900																	
	1901																	
	1902																	
	1903									2,200	100			2,200	100			2,200
Utah	1900																	
	1901	5,000	100											5,000	100			5,000
	1902									140,591	87.9	19,300	12.1	140,591	87.9	19,300	12.1	159,891
	1903	2,600	100			16,304	100			224,539	94.6	12,811	5.4	243,443	95	12,811	5	256,254

Wisconsin	1900	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	1901	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	1902	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	1903	......	......	......	......	280	100	......	......			......	......	280	100	......	......	280
Wyoming	1900	......	......	......	......	......	......	......	......	2,400	42.1	3,300	57.9	2,400	42.1	3,300	57.9	5,700
	1901	12,000	100	......	......	......	......		......	15,000	100	......	......	27,000	100	......	......	27,000
	1902	......	......	......	......	5,510	100	......	......	20,677	100	......	......	26,187	100	......	......	26,187
	1903	107,500	97.7	2,544	2.3	1,346,868	98.8	16,796	1.2	980,517	99.3	6,486	.7	2,434,885	99	25,826	1	2,460,711
Total	1900	190,307	88	23,655	12	183,361	89	21,609	11	70,997	74	25,183	26	444,665	86	70,447	14	515,112
	1901	145,816	92.5	11,771	7.5	94,719	87	14,306	13	86,432	96	3,315	4	326,967	91.8	29,392	8.2	356,359
	1902	45,638	81.7	10,195	18.3	342,272	94.3	20,663	5.7	339,607	91.3	32,394	8.7	727,517	92	63,252	8	790,769
	1903	157,946	98	3,229	2	2,173,059	98.4	34,371	1.6	1,558,555	98.5	23,001	1.5	3,889,560	98.5	60,601	1.5	3,950,161
Grand total	......	539,707	91.7	48,850	8.3	2,793,411	96.8	90,949	3.2	2,055,591	96.1	83,893	3.9	5,388,709	96	223,692	4	5,612,401

PATHOLOGICAL REPORT ON A CASE OF RABIES IN A WOMAN.[a]

By JOHN R. MOHLER, A. M., V. M. D.,
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GENERAL REMARKS.

While walking through a vacant lot on February 11, 1902, Mrs. J., colored, of Washington, D. C., was fiercely attacked and severely bitten on the right forearm, near the inner canthus of the left eye, and on the left frontal eminence by a stray collie dog. Eighteen days later the woman complained of a general malaise and pains in the cicatrized wounds of the head, which rapidly grew more severe, necessitating the services of a physician. Upon the latter's advice the patient was removed on the following day to Freedmen's Hospital, where the case was diagnosed as "suspected rabies." On the afternoon of March 3 the writer visited the hospital, on the invitation of Dr. William C. Woodward, District health officer, to whom we are indebted for the kindness of having brought this case to our attention. The patient was found in an extremely nervous condition, having an excessive feeling of fear and uneasiness. The eyes were staring, and a general expression of anxiety pervaded the countenance of the individual. The mind, however, was clear and no efforts at violence were made. When interviewed as to the cause of the scars on her head and forearm, she lightly replied: "Oh, a dog bit me there some weeks ago, but they are all right now."

From time to time reflex spasms involving the muscles of deglutition were noticed, causing a clutching at the throat and difficult breathing during the attack. These rapidly became more generalized, and in a few hours also involved the respiratory muscles, causing extreme dyspnea. Attempts at vomiting would then occur, but no evacuations followed. Contrary to the usual run of cases, the patient accredited these symptoms to indigestion and had not the slightest suspicion of the true nature of her condition, thus disproving the idea that the nervousness and fear usually seen in the early stages of rabies in the human subject are due to the natural dread of the disease and appre-

[a] This report was prepared for filing in the District Health Office, together with the records furnished by the attending physician, the hospital pathologist, and the resident physician. For this reason only those portions of the history and clinical symptoms that were brought to my attention will be given at this time.—J. R. M.

hension of the consequence rather than to organic changes in the central nervous system.

During the night these symptoms became more aggravated, and spasms followed one another more rapidly, causing grave delirium. The patient finally became violent, and necessitated the adoption of forcible measures to keep her under control. Death occurred on the following day, March 4, twenty-one days after the bites had been inflicted, and a postmortem examination was made by the hospital pathologist at noon. The cadaver showed a well-developed female about twenty-eight years of age. The heart, lungs, spleen, liver, kidneys, stomach, and intestines were apparently normal. The meninges of the brain were somewhat injected and the brain substance slightly edematous. Macroscopic examination of these tissues failed to reveal any pathological lesions which could be held accountable for the symptoms which resulted in death.

Following the necropsy, the medulla oblongata, the superior portion of the spinal cord, and the right plexiform ganglion of the pneumogastric nerve were removed under aseptic precautions, placed in sterile flasks, and brought to the Pathological Division of the Bureau of Animal Industry for an investigation of rabies.

A series of culture media consisting of peptonized beef bouillon, slant and stab agar, gelatin, blood serum, and fermentation tubes of saccharose, lactose, and glucose were inoculated from the center of the medulla oblongata, after searing the surface and making a transverse incision with a flamed knife. The absence of microorganisms was demonstrated by the failure of any of these various media to show fertility.

HISTOLOGICAL EXAMINATION.

A histological examination of the plexiform ganglion was made for the purpose of determining whether the lesions described by Van Gehuchten and Nelis[a] as typical of rabies were present. After fixation in a 10 per cent solution of formalin, it was transferred to 95 per cent alcohol, then to absolute alcohol, each for a period of two hours, placed in equal parts of alcohol and chloroform for one hour, chloroform one hour, chloroform and paraffin one hour, and paraffin six hours. The sections were stained in hematoxylin and eosin, Unna's polychromatic blue, and Van Gieson's picric acid and acid fuchsin. On microscopic examination, instead of finding the ganglion composed of the normal ganglionic cells surrounded by their capsules, consisting of a single layer of endothelial cells and situated in the interstitial neurogliar tissue (see Pl. I, fig. 1), a very different picture was observed. The large majority of the ganglion cells were found to be affected, but in varying degrees of intensity. (See Pl. I, fig. 2.)

[a] Diagnostic histologique de la rage, A. Van Gehuchten and C. Nelis, Annales de Médecine Vetérinaire, v. 49, Mai 1900, pp. 243–252.

The principal change observed was the extensive proliferation of the layer of endothelial cells of the capsule, although the leucocytic infiltration of the sustentacular tissue was also well marked. This proliferation and ingrowth of new cells from the capsule had invaded the pericellular spaces and the protoplasm of a number of the nerve cells and produced pressure on, and consequent atrophy of, the cytoplasm, thus leaving the nucleus surrounded by several layers of proliferated endothelial cells. In a few ganglion cells the pathological process had extended still further, causing a complete obliteration of the nucleus as a result of the invasion of the entire capsule by a dense mass of cells, causing these areas to assume a decidedly sarcomatous aspect. In other cells the changes were but slightly marked, the only observable alteration being an increase in the number of endothelial cells lining the capsule, the faint cell nuclei, or the poorly stained cellular protoplasm.

A portion of the medulla in the region of the apex of the corpora pyramidalia was fixed in the usual manner. After thorough dehydration in absolute alcohol the tissue was placed in a thin solution of celloidin for twelve hours, then into thick celloidin for an equal length of time. Sections were stained with alum hematoxylin and eosin, Van Gieson's picric acid and acid fuchsin, and Nissil's stains. The lesions observed were in part similar to the description given by Babes,[a] but not so extensive. A well-marked accumulation of embryonic cells about the blood vessels in the perivascular lymph spaces was seen and a leucocytic infiltration also observed surrounding some of the ganglion cells. These perivascular and periganglionic cell accumulations have been termed by Babes the "rabic tubercles," and are considered by him as diagnostic. Some of the blood vessels appeared dilated with an extensive proliferation of connective tissue cells of the adventia. The changes of the ganglion cells were not so marked. Disseminated swelling and disintegration of the Nissil bodies (chromatolysis) were present in some cells, while in others only tumefaction could be seen, with the cytoplasm taking the stain but feebly. In teased preparations the processes of the nerve cells appeared more or less distorted and atrophied, and vacuolation was occasionally observed. The latter was also manifest at times in the cells of the neuroglia.

INOCULATION EXPERIMENTS.

Within three hours from the time of removing the medulla from the cadaver (4 p. m., March 4, 1902), an oblongata emulsion had been injected into eight rabbits. This species of animal was used owing to

[a] "Sur certains caraterès des lésions histologiques de la rage," by V. Babes (Annales de l'Institute Pasteur, v. 6, No. 4, Apr., 1892, pp. 209–223).

"Rapid diagnosis of rabies by the examination of the bulb of the biting dog," by V. Babes, Vet. Jour., v. 51, No. 303, Sept., 1900, pp. 158–160.

their well-known susceptibility, and also on account of the classic symptoms produced after the development of the disease.

A cube about 1 centimeter in each dimension was removed aseptically from the bulb and placed in a sterile mortar, where it was thoroughly macerated into a homogeneous mass before the addition of sufficient physiological salt solution to give the emulsion the appearance of baker's yeast. The supernatant liquid was then drawn into the syringe and injected into full-grown rabbits averaging 1,280 grams in weight. Several methods of injection were followed in order to dispel, if possible, skepticism based upon inoculations that are made into the cephalic cavity. For this and other reasons two rabbits were injected with 0.5 c. c. of the emulsion into the substance of the splenius muscle in the posterior auricular region. Two others received 0.75 c. c. of the material in the great dorsal muscle at a point superior to the scapula. The remaining four animals were inoculated with 0.1 c. c. of the emulsion by trephining the frontal bone. In two (Nos. 66 and 67) a disk of bone was removed and the emulsion injected subdurally after the method of Pasteur. The other two (Nos. 64 and 65) were injected intracerebrally following the method advocated by Leclainche and Morel.[a]

In all these cases the usual method of procedure was adopted, namely, clipping off the hair, washing the seat of operation with a 5 per cent solution of carbolic acid, rinsing with sterile water, and then inoculating after the animals had been thoroughly anesthetized with ether. Following the inoculations, the animals recovered nicely from the effects of the anesthetic and the next day were as bright and as lively as at any previous time. As a control on this experiment, and in order to give further evidence that normal brain tissue will not produce rabiform symptoms, two rabbits were injected as checks with normal brain tissue—one by the intracerebral method and the other by inoculating into the great dorsal muscle. All the animals were placed under daily supervision, and it was noted that the operation wounds healed quickly by first intention. Not until the fourteenth day (March 18) was anything unusual observed, and on this day it was found that rabbits Nos. 65 and 67 refused their food; otherwise they appeared perfectly well. Temperatures were not taken at any time, as it was not desired to subject the animals to any unusual or exciting conditions. On the fifteenth day the rabbits previously mentioned showed symptoms of nervousness and irritability. When a stick was thrust at No. 65, attempts at biting it were made. On this date rabbits Nos. 64 and 66 showed anorexia.

Sixteenth day: Nos. 65 and 67 appeared dull and languid and remained crouched up, with respirations accelerated. Rabbit No. 64 showed the hyperesthetic condition noticed in the first two animals the

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[a] "Inoculation intra-cérébrale du virus rabique," by Leclainche and Morel, Annales de Médicine Vétérinaire, v. 49, 1900, pp. 88–89.

previous day, while No. 66 had evidently passed that stage and appeared stupid, with eyes half closed. During the morning it was crouched up in the corner of the cage, and at 4 p. m. was lying down, partially paralyzed.

Seventeenth day: No. 66 was found dead. Nos. 65 and 67 were partially paralyzed, but they could at times move about their cage. The former had two convulsions during the morning, and in the afternoon the convulsions became more frequent—one about every twenty minutes. At 4 p. m. this rabbit went down on its side with opisthotonos, and occasional attempts to recover its equilibrium were made. At noon, No. 65 lay prone on its belly, with forefeet outstretched and hind legs extended, without ability to recover itself. Masticatory movements were observed, with gritting of the teeth. At 4 p. m. No. 67 was likewise prostrate on its side, with head thrown back, and occasional efforts were made at locomotion. No. 64 remained very nervous, and frequently endeavored to burrow through the iron floor of the cage.

Eighteenth day: At 9 a. m. breathing could scarcely be noticed in No. 65. Death occurred one hour later. No. 67 remained in about the same position as the previous evening, but more enfeebled, with respirations almost imperceptible shortly after noon. Death occurred about 3 p. m. Rabbit No. 64 appeared dull and languid.

Nineteenth day: Rabbit No. 64 was found on its side, with opisthotonos and accelerated respirations.

Twentieth day: Rabbit No. 64 died during the night. Nos. 70 and 71 had no desire for food, but did not show any other indications of illness.

Twenty-first day: The two last-mentioned animals seemed to be easily excited, and on opening the cage made attempts at hiding their heads under their fellows. In the afternoon they appeared dull and listless. No. 69 showed anorexia.

Twenty-second day: At 9 a. m. the latter animal showed extreme lassitude, and was partially paralyzed by 4 p. m. No. 68 ate sparingly of its food.

Twenty-third day: No. 69 was found dead this morning, No. 70 completely paralyzed, and No. 71 died during the afternoon. No. 68 appeared hypersensitive.

Twenty-fourth day: No. 70 died. No. 68 did not develop further symptoms than those exhibited the previous day.

Twenty-fifth day: The latter animal was very languid, becoming totally paralyzed on the twenty-seventh and dying on the twenty-eighth day.

In order to exclude any intercurrent disease as the cause of death in these rabbits, various culture media were inoculated in the majority of cases from all the organs, including the brain. In but one instance (the liver of No. 66) did the medium become fertile, and this was an

obvious contamination probably due to the length of time the animal had been dead before making cultures. This negative evidence is of little value except incidentally to support the diagnosis of rabies. Postmortem examinations were made in all cases and the brain carefully examined, but, except a slight congestion or edema of the latter organ, no perceptible lesions were observed that could be held accountable for the symptoms produced. To obtain still more conclusive evidence, and to eliminate to even a greater degree the possibility of extraneous infection, a subseries of inoculations was made on March 22 by injecting 0.1 c. c. of a medulla emulsion from Nos. 67 and 65 intracerebrally into rabbits Nos. 212 and 211, respectively; 0.75 c. c. of a similar material from the brain of No. 69 was inoculated into the great dorsal muscle above the scapula of rabbit No. 281 on March 27. These animals were as lively the following day as usual, and did not develop any untoward symptoms until the thirteenth, fifteenth, and seventeenth day, respectively. The symptoms started in the same manner as was described for the first series, and ran approximately the same course, the rabbits dying on the sixteenth, seventeenth, and twenty-first day, respectively. The postmortem examination of these animals and culture-media inoculations from their viscera proved negative.

The following table will give a summary of results in a more convenient form for comparison:

Results of inoculation experiments for rabies.

Rabbit No.	Method of inoculation.	Dose injected.	Source of material injected.	Date injected.	Date of first symptom.	Date of death.	Period from inoculation to death.	Diagnosis.
First series:		*c. c.*					*Days.*	
64	Subdurally	0.1	Medulla, Mrs. J	Mar. 4	Mar. 19	Mar. 24	20	Rabies.
65	do	.1	do	do	Mar. 18	Mar. 22	18	Do.
66	Intracerebrally	.1	do	do	Mar. 19	Mar. 21	17	Do.
67	do	.1	do	do	Mar. 18	Mar. 22	18	Do.
68	Intramuscularly	.5	do	do	Mar. 26	Apr. 1	28	Do.
69	do	.5	do	do	Mar. 25	Mar. 27	23	Do.
70	do	.75	do	do	Mar. 24	Mar. 28	24	Do.
71	do	.75	do	do	do	Mar. 27	23	Do.
Subinoculations:								
211	Intracerebrally	.1	Brain rabbit No. 67.	Mar. 22	Apr. 6	Apr. 8	17	Do.
212	do	.1	Brain rabbit No. 65.	do	Apr. 4	Apr. 7	16	Do.
281	Intramuscularly	.75	Brain rabbit No. 71.	Mar. 27	Apr. 13	Apr. 17	21	Do.
Checks:								
72	Intracerebrally	.1	Normal brain tissue.	Mar. 4	(a)			
73	Intramuscularly	.75	do	do	(a)			

a Apparently healthy.

It will be seen from the above table that the rabbits inoculated with the oblongata emulsion from Mrs. J. have all succumbed with unmistakable and characteristic symptoms of rabies. Also that the three rabbits in the subseries likewise developed the typical paralytic form of rabies. Further, that the two check rabbits are still alive and their health apparently unimpaired at this writing.[a] As a result of the microscopic lesions found by the histological examination of the plexiform ganglion on the pneumogastric nerve and of the bulb of the medulla, also of the experimental inoculation of rabbits, it seems justifiable to conclude that the person in question was suffering with rabies at the time of death.

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[a] These animals were chloroformed eight months after inoculation and found to be in a healthful condition.

DESCRIPTION OF PLATE I.

Fig. 1. Section of normal plexiform ganglion stained with hematoxylin and eosin. Camera-lucida drawing made at the stage level with No. 4 compensating ocular and Zeiss 4 mm. objective.

Note the single layer of endothelial cells (*a*) lining the capsule of the ganglionic cells, the open pericellular space, and the appearance of the protoplasm and nuclei of the nerve cells (*b*).

Fig. 2. Section of the plexiform ganglion of Mrs. J. stained with hematoxylin and eosin. Camera-lucida drawing made at stage level with No. 4 compensating ocular and Zeiss 4 mm. objective.

The proliferation of the endothelial cells of the lining capsule (*a*) is well marked, as is also the destruction of the cell protoplasm (*b*) and the infiltration of leucocytes (*c*).

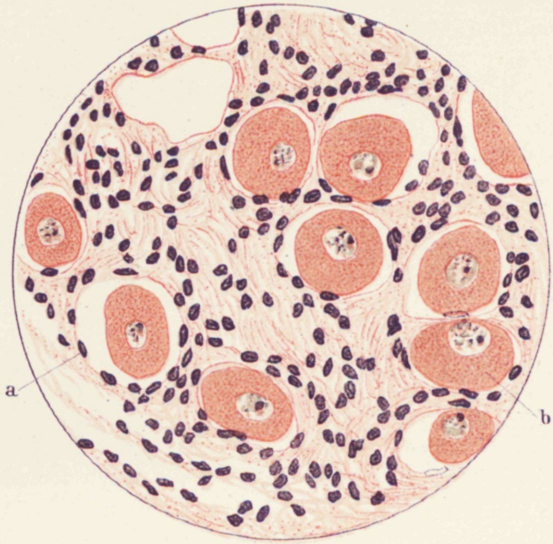

FIG. 1.—SECTION OF NORMAL NERVE GANGLION.

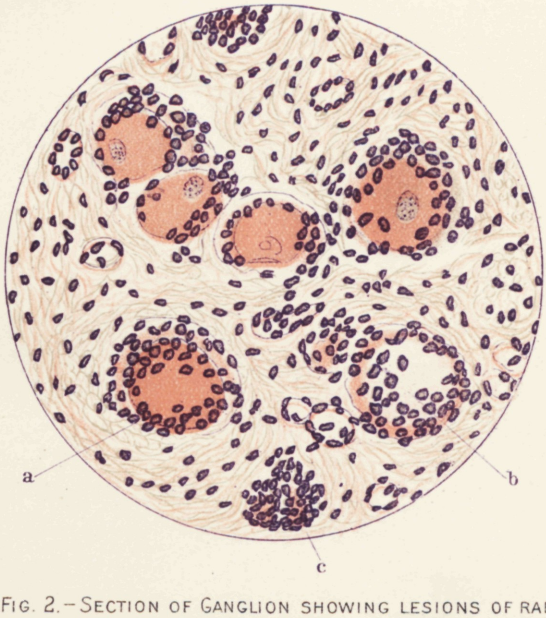

FIG. 2.—SECTION OF GANGLION SHOWING LESIONS OF RABIES.

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SPREAD OF TUBERCULOSIS AMONG HEALTHY CATTLE UPON EXPOSURE TO TUBERCULOUS CATTLE.

By E. C. SCHROEDER, M. D. V., and W. E. COTTON,

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A number of investigations have already been made regarding the rapidity with which tuberculosis spreads among healthy cattle, under various conditions, when exposed in stalls and stables previously occupied or occupied at the same time by cattle affected with tuberculosis. These investigations have generally shown that the introduction of a tubercular animal into a healthy herd will, in all probability, be followed by serious consequences in a comparatively short period of time. In fact, a healthy herd of cattle, through the introduction of a tubercular cow, in the light of the following experiment and the investigations above referred to, may in less than a single year become entirely tubercular. The importance of this fact not only in its simple economical bearing on the cattle industry, but also on the public health, is so great that it can hardly be sufficiently accentuated. This is especially true when the subject is contemplated in connection with the now well-established reputation of tuberculin as a diagnostic agent in tuberculosis, and the knowledge that, through the proper use of tuberculin, healthy herds of cattle can almost with absolute certainty be protected from exposure to tubercular cattle, and tubercular cattle can readily be separated from other cattle which have not yet become affected.

On January 27, 1903, in the following experiment 7 healthy cattle and 3 tubercular cows were confined in a stable containing 10 box stalls. The stalls were separated by solid 2-inch plank partitions, 6 feet high. Five of the healthy cattle and the 3 tubercular cows occupied different stalls each day, in a rotation which exposed each of the healthy cattle equally to the 3 tubercular cows. Two of the healthy cattle occupied stalls near the center of the stable and were at no time allowed to enter other stalls or to come into closer contact with any of the other cattle.

On April 10, 1903, 1 of the 3 tubercular cows was removed from the stable, and 2 other and more severely affected cows were introduced. On June 12, 1903, 1 of the latter died and was found on autopsy to be affected with generalized tuberculosis; however, without disease of the udder or lymph glands associated with or near the udder. Eight guinea pigs which were fed the milk of this cow from

April 6 to June 8 were killed about two months after the feeding ceased and were found to be unaffected. Three guinea pigs received on April 15, 1903, each an intraabdominal injection of 5 c. c. of milk from this cow. Two of the guinea pigs died, respectively, on June 11 and June 29, affected with generalized tuberculosis, and the third was killed on September 4, 1903, and was found to be fat and free from all lesions of disease.

The 4 other tubercular cows used in the experiment are alive at this time [November 7, 1903]. Guinea pigs fed the milk of these cows remained healthy, and the same is true of guinea pigs which received intraabdominal injections, with the exception of the milk from 1 cow, which on injection caused generalized tuberculosis in 2 of 3 guinea pigs. The latter cow was one of the 2 introduced into the stable on April 10. The other 3 cows were so slightly affected with tuberculosis that the presence of the disease would have escaped the casual observer.

A record of the exposed cattle follows:

Bull No. 263, yearling; in good condition; tested with tuberculin without reaction.

January 27, 1903.—Placed in stable with tubercular cattle. Occupied a stall about the center of the stable, which was separated from the other stalls by a 6-foot-high solid 2-inch plank partition. At no time did he enter a stall which had been previously occupied by a tubercular animal.

June 30, 1903.—Tested with tuberculin and gave a reaction which reached 3.6° F., at its highest point.[a] General condition, excellent.

August 3, 1903.—Killed and examined postmortem. Autopsy record follows: General condition, excellent. Posterior mediastinal glands are slightly enlarged and contain numerous small recent foci of tuberculosis. The anterior mediastinal glands are greatly enlarged and are filled with foci of tubercular material. Bronchial glands contain several small foci of recent tubercular disease.

Cow No. 257, about six years old; in good condition; tested with tuberculin without reaction.

January 27, 1903.—Placed in stable with tubercular cattle. Occupied a stall about the center of the stable, which was separated from the other stalls by a 6-foot-high solid 2-inch plank partition. At no time did she enter a stall which had been previously occupied by a tubercular animal.

June 25, 1903.—Produced a healthy female calf.

June 30, 1903.—Tested with tuberculin without reaction.

August 3, 1903.—Killed and examined postmortem. Autopsy record follows: Several of the mediastinal glands are greatly enlarged and thickly sprinkled with small tubercular nodules, which are recent in character. Several small recent areas of tubercular disease sprinkled through the lung. The liver is adherent to the diaphragm in several places by bands of firm, white connective tissue. No tubercular lesions in the liver or portal glands. The right hind quarter of the udder is indurated, and the proper secreting tissue has been replaced by a thick, dense network of connective tissue supporting small masses of fat. This quarter of the udder secreted practically no milk. The other quarters of the udder healthy. The disease of the

[a] The amount of reaction in all these cases is determined by subtracting the highest temperature on the day before injection with tuberculin from the highest temperature on the following day.

udder was not of a tubercular character. As this cow gave no reaction when she was tested with tuberculin a little over a month before her death, it was believed wise, notwithstanding the typical character of the tubercular lesions in the mediastinal glands and lung, to confirm the diagnosis by guinea-pig injection; hence, 2 guinea pigs were inoculated with small fragments of tubercular material from the mediastinal glands. One of the guinea pigs died two months after the inoculation, affected with generalized tuberculosis; and the other guinea pig was killed two months after the inoculation and found to be affected with generalized tuberculosis.

The calf of cow No. 257 was killed on August 3, 1903, and careful examination failed to show any lesions of disease whatsoever. The failure of this cow to react when tested with tuberculin on June 30 may be due to the fact that she produced a calf only five days before the test was made.

Heifer No. 293, about eighteen months old; in good condition; tested with tuberculin without reaction.

January 27, 1903.—Placed in stable with tubercular cattle, and made to occupy a different stall each day, together with a number of other cattle, which caused her to be exposed equally with the other cattle to several tubercular cows.

June 30, 1903.—Tested with tuberculin and gave a reaction which reached 2.8° F. at its highest point. General condition of heifer is very good.

August 3, 1903.—Killed and examined postmortem. Autopsy follows: One small focus of tubercular disease in the center of the left principal lobe of the lung. Several of the pharyngeal glands show patches of reddening, but no well-defined lesions. Sprinkled over various portions of the pulmonary pleura of the right principal lobe of the lung are numerous minute tubercles and groups of tubercles; corresponding tubercles are present on the costal pleura. The pulmonary surface of the diaphragm is sprinkled with numerous small tubercles and groups of tubercles, and the various lobes of the lungs are adherent to each other and the diaphragm by means of tissue thickly sprinkled with tubercles. The lesions had the typical character of pearl disease in cattle.

Heifer No. 296, about six months old; in good condition; tested with tuberculin without reaction.

January 27, 1903.—Placed in stable with tubercular cattle and exposed by moving from stall to stall in the same manner as heifer No. 293.

June 30, 1903.—Tested with tuberculin and gave a reaction which reached 2° F. at its highest point. General condition is good.

August 5, 1903.—Killed this date and examined postmortem. Autopsy record follows: The left principal lobe of the lung is adherent over a small area to the chest wall; near the adhesion is a tubercular nodule in the lung tissue about 1 inch in diameter. The mediastinal glands, posterior and anterior, the bronchial glands, and the lymph glands about the root of the tongue are greatly enlarged, and either entirely tubercular or thickly sprinkled with minute tubercular foci. Several of the mesenteric lymph glands are converted, to the extent of one-half their entire substance, into tubercular material, and a number of other mesenteric glands show small tubercular foci. Glands at the brim of the pelvis in the abdominal cavity show tubercular lesions. The lesions all are of comparatively recent character, and show no tendency to break down or soften.

Bull calf No. 255, about six months old; tested with tuberculin without reaction; in good condition.

July 12, 1902.—Injected into right jugular 20 c. c. of dead human tubercle culture. The culture was grown in the biochemic laboratory of the Bureau of Animal Industry, and was marked No. 59, meaning that it was of the fifty-ninth generation grown

on artificial culture media. The culture was killed at the Experiment Station by exposing it to a temperature of 98° C. for one hour. Two guinea pigs were injected with a portion of the dead culture and were killed two and one-half months later, and were found to be in excellent condition and free from all lesions of disease. The injection of the calf was followed by no adverse condition.

January 27, 1903.—Tested with tuberculin without reaction, and was afterwards placed in stable with the tubercular cattle and exposed by moving from stall to stall in the same manner as heifer No. 293.

June 30, 1903.—Tested with tuberculin, and gave a reaction which reached 2.6° F. at its highest point. General condition is good.

August 6, 1903.—Killed this date and examined postmortem. Autopsy record follows: The thoracic walls and the surface of the diaphragm where the lung rests against it are covered with minute shreds of fibrous exudate of a pale-red color. The lung is adherent to the chest wall and the diaphragm in several places. In the mediastinal glands are a number of tubercular foci; the foci in the anterior are somewhat larger and more numerous than in the posterior glands. The lymph glands back of the pharynx are five times their normal size and completely tubercular. In the liver are a number of small recent foci of tuberculosis. The portal glands are sprinkled with minute hemorrhagic points, but show no lesions of tuberculosis. Two guinea pigs were inoculated with tubercular material from this animal, and both died about two months later affected with generalized tuberculosis. The object in making the guinea-pig injections was to remove any suspicion which might exist regarding the possibility that the extensive characteristic tubercular lesions could have been caused by the intravenous injection of dead tubercle germs made on July 12, 1902.

Heifer calf No. 261, about four and one-half months old; tested with tuberculin without reaction; is in good condition.

July 19, 1902.—Injected into right jugular 20 c. c. of dead bovine tubercle culture. The tubercle culture was grown in the biochemic laboratory of the Bureau of Animal Industry, and was marked Bovine III, 37. The culture was killed at the Experiment Station by exposing it to a temperature of 98° C. for one hour. Two guinea pigs were injected with a portion of the dead culture, and were killed two and one-half months later, and were found to be in excellent condition and free from all lesions of disease. In the calf the injection was followed by no symptoms of disease.

January 27, 1903.—Tested with tuberculin without reaction, and was afterwards placed in stable with tubercular cattle and exposed by moving from stall to stall in the same manner as heifer No. 293.

June 30, 1903.—Tested with tuberculin, and gave a reaction which reached 3° F. at its highest point, notwithstanding that its temperature on the day before injection with tuberculin was quite high.

August 5, 1903.—Killed this date and examined postmortem. Autopsy record follows: At the seat of the intrajugular injection of dead bovine tubercle culture is a small abscess about 1½ inches in diameter, which contains soft, creamy pus.[a] Several of the mediastinal glands and the bronchial glands contain each from one to six tubercular foci. One mesenteric gland contains one tubercular focus one-fourth inch in diameter. Two guinea pigs were inoculated with small fragments of tubercular tissue from this animal, and 1 died about two months later and the other was killed

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[a] When intravenous injections are made of either dead or living, human or bovine tubercle cultures, an abscess of the kind here described is almost certain to develop if any portion of the culture leaks from the vein or the syringe into the surrounding tissue. Hence, in this case, when the sterility of the culture used was tested on guinea pigs the lesion has no particular significance.

about two and one-half months later. Both were affected with generalized tuberculosis. The object in making guinea-pig injections in this case was the same as in the case of No. 255.

Cow No. 211, about two years old; tested with tuberculin without reaction.

July 19, 1902.—Injected into right jugular 10 c. c. of moderately virulent human tubercle culture.

July 25, 1902.—Gave birth to a healthy calf.

August 6, 1902.—The above injection repeated.

August 8 to 18, 1902.—Suffered from accelerated respiration and loss of appetite.

August 19, 1902.—Has grown quite thin, but seems to be in good general health. The reduction in condition is probably due to the milk secreted for her calf, which latter is in excellent health and growing vigorously.

August 20, 1902.—A third injection of moderately virulent human tubercle culture was made (10 c. c.) into right jugular vein.

September 20, 1902.—A fourth injection of 10 c. c. of human tubercle culture was made into right jugular vein.

October 7, 1902.—A fifth injection of 10 c. c. of moderately virulent human tubercle culture was made into right jugular vein. Each of the five injections was followed by an elevation in temperature of from 2° to 4°, which lasted from three to seven days, and by more or less acceleration in respiration.

December 12, 1902.—The calf was weaned.

January 27, 1903.—The cow is quite thin and looks unthrifty. Is producing about 1 gallon of milk daily. Was tested with tuberculin without reaction, and placed in stable with tubercular cattle and exposed by moving from stall to stall in the same manner as heifer No. 293.

April 3, 1903.—Is thin, but seems to be in perfect health.

June 10, 1903.—Is improving in condition. Still producing milk.

June 30, 1903.—Tested with tuberculin without reaction.

August 6, 1903.—Killed this date and examined postmortem. Autopsy record follows: The entire lung is sprinkled with minute white nodules about 1 mm. in diameter. The appearance is similar to that observed on several occasions at the Experiment Station after injection of human tubercle culture into the veins of cattle. There are thousands of little nodules present, and a few as much as 2 mm. in diameter. The mediastinal glands contain a number of circular red patches, but no tubercular lesions. The costal and pulmonary pleura show considerable thickening and roughening. The liver contains a number of necrotic areas of parasitic origin. Two guinea pigs were inoculated with fragments from the red circular patches in the mediastinal glands. These guinea pigs were killed two and one-half months later, and were found to be in excellent condition and free from all lesions of disease. Two guinea pigs were inoculated with minute nodules from the lung. One died after two months, affected with generalized tuberculosis, and the other was killed two and one-half months after inoculation and was found to be affected with generalized tuberculosis.

The tubercular character of all doubtful lesions was confirmed either by microscopic examination or guinea-pig injection. An examination of the records of the cattle shows that every one of the 7 healthy animals exposed a little more than six months to tubercular cattle contracted the affection, with the possible exception of cow No. 211.

Cattle Nos. 255 and 261 received each an injection of dead tubercle culture—one human and the other bovine; these injections were made

in connection with another experiment regarding the effects of dead tubercle culture injections on cattle. The 2 cattle were specially selected for the exposure experiment because it was desirable to determine whether the injections received had affected their susceptibility to tuberculosis. It is clear from the results that the dead culture injections made in July, 1902, had no influence on the exposure beginning in January, 1903.

Cow No. 211, which received five intravenous injections of live human tubercle culture, was included in the exposure at the request of Dr. E. A. de Schweinitz, of the Biochemic Division. The injections in this case were made, in connection with the injections of a number of other animals, in an experiment concerning the immunization of cattle to tuberculosis.

The lesions observed on autopsy in cow No. 211 are undoubtedly the result of the intravenous injections received previous to the exposure. This conclusion is drawn from the fact that it is not probable that a simple stable exposure would have caused thousands of independent centers of disease, all of the same age, to develop in the lung, without a single tubercular lesion in any other portion of the body. It is very likely that the germs introduced into the jugular vein passed along the circulation to the right chambers of the heart, and from there to the lung, where they were entirely filtered out of the blood, and caused a tubercular disease. This disease, it is fair to assume, was of a temporary character, and would have ended in complete recovery if the cow had not been killed.[a] The condition found is very significant.

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[a] A case like the following shows the extensive lung disease which may result from an intravenous injection either of an attenuated tubercle culture or a tubercle culture in which the life of the germ has been destroyed: Sheep No. 46, in excellent health, tested with tuberculin without reaction. On July 19, 1902, received an injection into the right jugular vein of 10 c. c. of dead bovine tubercle culture. The culture was killed by exposing it to a temperature of 98° C. for one hour. Several guinea pigs were injected with portions of the culture as a check on its sterility. The guinea pigs were killed three and one-half months later and found to be in excellent condition and free from all lesions of disease. The sheep was killed on January 6, 1903, not quite six months after the injection was made, and the following lesions found: Sprinkled over the entire surface of the lung, immediately under the pleura, are innumerable minute tubercles, all of about the same size, 1 mm. diameter, excepting where several have coalesced. Similar tubercles are found, on section, to be sprinkled throughout the lung tissue. (In every respect these tubercles were like the tubercles found in the lung of cow No. 211.) The minute tubercles were somewhat more numerous in the caudal portion of the principal lobes of the lung than in other portions of the organ. The distance between the tubercles was from one-half to 1 cm., excepting in a few regions, in which areas of the lung about 3 cm. square were thickly beset with very minute necrotic points. The general appearance was that of miliary tuberculosis of the lung. The individual tubercles had the appearance of opaque, pearl-gray points, surrounded by a ring of translucent, glistening tissue. Mediastinal and bronchial glands free from disease, with the exception of a few reddened patches. One of the throat glands was entirely necrotic. All other organs

If it is preferred to attribute the lesions to the exposure in the stable, the conclusion must be drawn that the tubercle culture injections failed to produce immunity. On the other hand, if the lesions are attributed to the immunizing injections, it is clearly shown, by the death of the guinea pigs injected with fragments of the lung, that living tubercle germs were still present ten months after the last injection was made, a condition which certainly is very objectionable in a method which has for its primary object the prevention of tubercular disease. While there is no desire on the part of the writers to urge or support the views of Doctors Koch and Smith with respect to the difference between the human and the bovine tubercle bacilli, to which we are really opposed, it seems, nevertheless, in the present unsettled state of the question, that we should not make cattle a repository for human tubercle bacilli in order to protect them from bovine tuberculosis.

The rapidity with which tuberculosis spreads in stables occupied by tubercular cattle is shown with particular emphasis by the 2 cattle, Nos. 263 and 257, which became tubercular without actual contact with the tubercular cows, in stalls which were separated from the other stalls by solid partitions 6 feet high. The distribution of the lesions in the several cattle merits some attention, although it is not possible to draw definite conclusions from so small a number of animals regarding the organs which are more apt to become affected in an exposure of the kind practiced. In a general way, 5 of the 7 cattle showed lesions in the mediastinal lymph glands, 3 in the bronchial glands, 4 in the lungs, 2 in the throat glands, 2 in the mesenteric glands, 1 in the liver and portal glands, 1 in the lymph glands at the brim of the pelvis, and 2 showed disease of the pulmonary surfaces of the lungs and thorax. It would seem from this distribution that the germs of tuberculosis in stall and stable infection are more commonly respired than ingested with food. The importance of this condition lies in the fact that it points out clearly that cattle can not be protected from tuberculosis in stables with tubercular cattle by restricting carefully each animal to its own individual stall.

Finally, it is interesting to know that 100 guinea pigs were exposed to tubercular infection in this experiment. The guinea pigs were divided into twenty lots, and one lot placed in a wall cage in each stall and one lot in a cage constructed below the manger in each stall. The

normal. Three guinea pigs injected with material from the lung, and 3 with material from the throat gland, were killed eight months later, and found to be in excellent condition and free from all lesions of disease. Sections made of the nodules in the lung of the sheep and examined under the microscope showed the presence of innumerable tubercle bacilli. In other words, the dead germs not only caused extensive disease, but were retained in countless numbers in the tissues for very nearly six months. The sheep at no time following the injection showed symptoms of disease, and remained in excellent condition, and was fat and apparently in perfect health when it was killed.

manger cages were so arranged that a constant sifting of food should occur from the mangers to the guinea-pig cages while the cattle were eating. Among the 100 guinea pigs 2 died early during the exposure as the result of pneumonia. Of the remaining 98, all of which were exposed throughout the entire time of the exposure of the cattle, only 1 guinea pig became affected with tuberculosis. This pig was exposed in one of the manger pens.

During the experiment three cats lived in the stable used for the exposure and were fed the mixed milk of the several tubercular cows. In addition to the milk, the cats received no other feed excepting such rats or mice as they could catch for themselves. The cats were killed and upon careful examination after death were found to be free from lesions of tuberculosis.

SOME OBSERVATIONS ON THE TUBERCULOSIS OF ANIMALS.[a]

By D. E. Salmon, D. V. M.,
Chief of the Bureau of Animal Industry.

The tuberculosis of animals is a subject of very great importance from more than one point of view. To the agriculturist, the economist, the statesman, it causes, or should cause, anxiety because of the loss of food-producing animals which it occasions and because of its tendency to counteract the efforts of breeders to improve the quality of such animals. To the physician and the sanitarian it must be a matter of grave concern because of the possibility of its having an injurious effect upon the public health. To every citizen who possesses the finer feelings developed by civilization, intelligence, and cultivation, it must be a matter of some solicitude as to whether the steak which he eats for his breakfast was cut from the carcass of a steer affected with generalized tuberculosis or whether the milk which he drinks with his luncheon was produced by a cow having tuberculosis of the udder. However, in the remarks which I have the privilege of making before this audience, I shall treat the subject of animal tuberculosis from a medical point of view, with especial reference to the lessons of comparative pathology.

There are two questions of superlative interest before the medical profession at this time relative to animal tuberculosis: First, Is animal tuberculosis communicable to man? Second, In case it is communicable to man, how frequently does such transmission occur? Clinical observation has not been able to give us satisfactory answers to these questions, and experimentation has been forced to approach them by more or less indirect routes, which necessarily has made the evidence obtained somewhat inconclusive and liable to more than one interpretation. It appears, however, that some rays of light are beginning to penetrate the obscurity and that all must soon agree upon the answer to the first of the questions which I have just formulated. The second question can not be answered definitely for a long time to come.

WIDE RANGE OF ANIMAL SPECIES AFFECTED WITH TUBERCULOSIS.

In the whole list of infectious diseases of animals there is probably not one which affects a larger number of species, or species which are

[a] Paper read before the Tuberculosis Exposition, at Baltimore, Md., January 28, 1904.

more widely separated as to the position which they occupy in the scale of animal life, than tuberculosis. Not only does it affect most mammals, such as man, monkeys, horses, cattle, sheep, hogs, goats, dogs, cats, guinea pigs, rabbits, mice, rats, camels, zebras, giraffes, deer, bear, lions, tigers, jackals, panthers, leopards, foxes, etc., but it affects birds, such as poultry, pheasants, pigeons, parrots, canaries, and other species, and it also affects fish, frogs, and snakes. It is most remarkable that a bacillus which has proved so difficult of cultivation in the laboratory has been found capable of causing disease in fish, amphibia, reptiles, birds, and mammals. The difference in chemical composition and, above all, in temperature between birds and fish, from a bacteriological point of view, is tremendous, and yet it is conclusively established that both may be affected with tuberculosis and that the etiological factor in each case is Koch's bacillus.

THE COMMUNICABILITY OF TUBERCULOSIS BETWEEN DIFFERENT SPECIES OF ANIMALS.

The communicability of tuberculosis among numerous species of mammals has been experimentally demonstrated. I shall not undertake to give an exhaustive list of such species, as a brief statement is sufficient for the purpose which I have in view at this time. The infection of rabbits and guinea pigs with both human and bovine bacilli is a common experience. Koch [1] [a] successfully inoculated field mice, white rats, rabbits, cats, and a marmot from the ape. De Schweinitz [2] infected apes with both human and bovine tuberculosis. Dogs and pigs have been infected with both human and bovine bacilli by several investigators. The horse, goat, sheep, and cat have been readily infected with bovine tuberculosis. Mohler has infected goats with human tuberculosis. Theobald Smith [3] infected guinea pigs from the nasua, and guinea pigs and rabbits from hogs. De Jong [4] infected goats with both human and bovine tuberculosis. Courmont and Dor [5] infected fowls with material from both human and bovine sources, and also guinea pigs and rabbits with avian tuberculosis. Fish, frogs, and other cold-blooded animals have been infected with both human and bovine tuberculosis in the experiments of Dubard,[6] Dieudonné,[7] and Herzog.[8] Bovine animals have been infected with bacilli from human sources by Ravenel, de Schweinitz, Mohler, and Theobald Smith in the United States, and by De Jong, Delépine,[9] Orth,[10] Stenström,[11] Fibiger and Jensen,[12] Max Wolff,[13] Nocard,[14] Arloing,[15] Behring,[16] Dean and Todd,[17] and others abroad, notably by the German tuberculosis commission, as reported by Kossel.[18]

Not all attempts to infect one species of animals with tubercle bacilli obtained from a different species of animals are successful. Indeed,

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[a] Figures refer to the bibliography at the end of this article.

failures often occur in attempting to inoculate tuberculosis from individual to individual within the same species. These differences in results have been due to three causes: (1) Variation in the number of bacilli inoculated; (2) variation in the virulence of the bacilli inoculated; (3) variation in the resisting power of the animals used in the experiments. In the later experiments, bacteriologists have taken precautions to administer uniform doses of bacilli, so that the first factor mentioned as tending to produce variable results has been to a great extent eliminated. However, the difference in the pathogenic activity of bacilli from different sources, and the varying power of resistance possessed by different individuals of the same species, and to a greater degree by individuals of different species, are factors which must always have an influence upon the result, and must, for that reason, always be taken into account.

The important problems in the great subject of tuberculosis are not so simple that they can be solved by an experimenter who ignores the work of others and starts out with a few cultures of bacilli and a few experimental animals to settle the whole question by himself and on his own lines, as some enthusiastic gentlemen have discovered during the last few years. All lines of experimentation must be considered, and where there is an apparent lack of harmony the reason for it must be discovered before dogmatic conclusions are promulgated. Above all, we should endeavor to discriminate between positive and negative results and not make the mistake of ignoring or suppressing the experiments which demonstrate something, in order that we may accept perhaps the more numerous ones which have not succeeded and which are absolutely barren as a source of information. The field of comparative medicine is a broad one, and it is the part of wisdom for those engaged in human medicine to look to it for the solution of those difficult problems which have so long eluded their grasp.

DIFFERENCES OBSERVED IN THE TUBERCLE BACILLUS FROM DIFFERENT SOURCES.

The study of avian tuberculosis throws considerable light upon the subject of the variation of the tuberculosis virus. This type of bacilli, obtained from certain birds, is very virulent for fowls, while it is extremely difficult to infect fowls with human tuberculosis; dogs are refractory to the avian bacilli, but are quite susceptible to the human; guinea pigs are extremely susceptible to human bacilli, but in a majority of instances resist the avian; and, strangely enough, rabbits appear to be equally susceptible to the avian and the human types.

The human bacillus, as is well known, grows between the temperature limits of 30° and 40° C., while the avian is able to grow between the limits of 25° and 45° C.; that is, the avian is able to grow through a range about 5° higher and 5° lower than the human bacillus. The

cultures of human tuberculosis appear dry, scaly, or verrucose, dull, and hard; those of the avian are moist, oily, wrinkled, and soft. The human bacillus does not vegetate at all at 43° C., while the avian multiplies rapidly and abundantly at that temperature. The avian bacilli are longer, thinner, and more granular than the human bacilli.

An equally interesting type of tubercle bacilli was obtained by Král and Dubard[19] from tubercular carp. This bacillus was able to vegetate between the temperature limits of 10° and 37° C.; that is, it could not grow at as high a temperature as the human by 3°, but it could grow at a point 20° lower. It is very vigorous in its development, the rods at first being short and broad, but in cultures growing into long, branched filaments. On veal-broth agar, after twenty-four hours' vegetation at ordinary temperatures, there already exists a visible trace of the culture, which by the twelfth day becomes white, smooth, and shiny like the avian.

Another extremely interesting type of the *Bacillus tuberculosis* was described by Friedmann,[20] having been obtained from a tuberculous turtle. This bacillus was able to vegetate even at the freezing point, and the temperature limits of its growth were placed by the observer at 0° to 43° C. It was, therefore, able to grow at a temperature even higher than the human bacillus and at 30° lower. Friedmann says that, as A. Kayserling correctly points out, it is often impossible to establish morphological differences between the individual bacilli in pure cultures of various kinds of tubercle bacilli, such as human, avian, piscine, and blindworm; yet he found in many preparations made from pure cultures that the bacilli of piscine, blindworm, and frog tuberculosis were considerably shorter and usually thicker than the human and bovine or the turtle bacilli, even when the latter were grown at the lower temperatures.

These examples of tuberculosis affecting animals which differ so remarkably from each other, and these tubercle bacilli which vary considerably in their morphology and even to a greater extent in their cultural characteristics, have led pathologists to inquire if this tuberculosis of man and other mammals, of birds, of reptiles, of amphibians, of fish, was indeed one and the same disease. In fact, they have gone further than this and have seriously raised the question as to whether the human and bovine bacilli of the mammalian type produce an identical disease, and as to whether human tuberculosis can be made to infect bovine animals or bovine tuberculosis to infect man.

These questions are very important, since they indicate a possible source of human infection, which, if demonstrated, would require special sanitary regulations for its suppression. There is a great difference from a prophylactic point of view whether a disease is confined to one species of animals which may be readily placed under supervision and control, or whether it affects numerous species, some of

which are almost beyond our reach. If mankind is susceptible only to human tuberculosis, the problem of controlling this disease in the human speciės is greatly simplified; but if the infection of man occurs from animals, and particularly from the domesticated animals with which he is closely associated and which produce such an important part of his food supply, then new centers of infection must continually occur until this source of danger is eliminated. Direct experiments to show whether man can be infected with animal tuberculosis are for obvious reasons impossible, and the deductions from clinical observations are uncertain and often misleading; we must, therefore, form our opinions from our general knowledge of the behavior of tubercle bacilli as they are studied in different species of animals and under different conditions of environment.

Theobald Smith[3] has devoted much study to human and bovine bacilli and has pointed out differences which he considers sufficient to constitute distinct types. He says:

> With one exception (one out of seven) the human bacilli grew from the start much more vigorously than the bovine bacilli. With several the rapidity of growth was surprising. After two weeks these cultures appear as a whitish surface layer of a pearly luster of varying thickness. The bovine cultures show merely discrete colonies, or a thin, uniform layer having the appearance of ground glass. This difference in the vigor of growth has, in general, maintained itself, with the slowly increasing tendency of all cultures to multiply more rapidly.
>
> The size of bovine bacilli in the various cultures was quite constant. They were all quite short, usually about 1 to 1.5 μ long, more rarely 1 to 2 μ. These measurements do not tend to change appreciably with prolonged cultivation. The bacilli are straight, not very regular in outline. Some are broader at one end than at the other, some broader in the middle than at either end; i. e., spindle shaped. Some may be so short as to resemble oval cocci. With the human bacilli the form was not so constant. The earliest cultures of Sput. II, IV, V, and VI contained forms from 1 to 2 μ long, hence closely approximating the bovine forms. Others may be longer from the start. In all, however, there is a tendency not noticed among bovine cultures, to grow longer under artificial cultivation. * * *
>
> In the earliest cultures, therefore, morphological differences are not necessarily characteristic, and can not aid us in attempts at determining the origin of cultures. * * *
>
> If we undertake to summarize the observations made with microscope and culture tube upon these bacilli we somewhat hesitatingly formulate the following general statements:
>
> (1) Bovine and other animal bacilli (except *Nasua*, which is regarded as coming from man) grew less vigorously for a number of generations than the sputum bacilli. Sputum I is an exception and is probably an atypical form.
>
> (2) Bovine bacilli are much less influenced by certain modifications of the culture medium.
>
> (3) Bovine bacilli tend to remain short; human bacilli are either more slender from the start or become so during cultivation.

Recently Smith[21] has given another and perhaps more definite distinguishing feature between human and bovine bacilli. If ordinary bouillon prepared from fresh beef with 3 to 5 per cent glycerin added

be used, and if the acidity be made equivalent to about 2 per cent of normal acid, phenolphthalein being the indicator, the reaction of the bouillon during the formation of the membrane approaches the neutral point or becomes slightly alkaline in the case of bovine bacilli, but remains acid in the case of human bacilli.

MODIFICATION OF THE MORPHOLOGY AND VIRULENCE OF TUBERCLE BACILLI BY CULTURE AND BY PASSING THROUGH VARIOUS SPECIES OF ANIMALS.

In the study of avian tuberculosis it was found that the great majority of inoculations of fowl tuberculosis to guinea pigs, and of mammalian tuberculosis from guinea pigs to fowls, failed to infect. There were some who concluded that the disease could not be transmitted between these species. However, it was found that an occasional guinea pig when inoculated with avian tuberculosis would succumb with generalized visceral granulations, and after passing through a number of mammals this bacillus of avian origin may become very virulent for the guinea pig and even pathogenic for the dog, and at the same time may lose its virulence for the Gallinaceæ. Cadiot, Gilbert, and Roger[22] succeeded in infecting fowls with tuberculosis of canine origin. A fowl which had been inoculated and fed with tubercular material from the dog was found at the autopsy to have granulations in the liver, spleen, and kidneys, and tuberculous ulcerations of the intestine. The bacilli from this fowl seemed to have been modified somewhat and to have acquired the pathogenic properties which made a sort of intermediate type between the human and the avian. Another fowl, inoculated from the liver of the first, died at the end of one hundred and twenty-one days with tubercles at the point of inoculation and numerous granulations of the peritoneum, liver, spleen, ovaries, and lungs. It had not entirely lost its original properties, however, for, inoculated upon a dog which was killed at the end of three months, it caused the formation of tubercles in the liver, kidneys, and the lungs. From subsequent investigations these authors[23] conclude that, by injecting horse serum into the abdominal cavity of fowls every ten days, the natural immunity of these birds from mammalian tuberculosis is so greatly diminished that they can be almost invariably infected by inoculation.

Dubard,[6] in studying the tuberculosis of carp, concluded that the infection was caused by the contamination of the ponds with tubercular material from the human subject, on account of "the exact coincidence of the appearance and of the cessation of the disease of the fish with the appearance and the disappearance of contamination of the ponds by human tubercular products." This observation led him to make experiments, in which he says he succeeded many times in producing the piscine type of tuberculosis by inoculating cold-

blooded animals with pure standard cultures of the tubercle bacillus. He found all cold-blooded animals with which he experimented susceptible to human tuberculosis. The most susceptible were the gray lizards and frogs; the least susceptible were the adders and the voracious fishes. Král and Dubard[19] state that one of them has demonstrated that the bacillus of Koch by passage through cold-blooded animals acquired the property of developing at ordinary temperatures on all the laboratory media. At the same time these cultures, which have the greatest resemblance to those of ordinary tuberculosis, lose their pathogenic power for animals of constant temperature. The facility with which this modified bacillus grows, the rapidity with which it accomplishes its vital cycle, which appeared to the authors very complete, the dichotomic filamentous forms that it presents in the course of its evolution, seemed to them an exaggeration of what occurs with the tuberculosis previously known. It was found that the maximum temperature at which it would grow was below 30° C., and it was only after great difficulty that they succeeded in obtaining cultures at 37° C. However, by proceeding progressively they succeeded in conquering its repugnance to elevated temperatures. The same result might be obtained by inoculating lizards that are kept in an incubator. There is thus produced a select race which grows well at 37° C. It is much more easily cultivated on a new soil than the human bacillus, and is only slightly sensitive to variations of the acidity or alkalinity of the media, but is otherwise very sensitive to sudden changes of the chemical composition of such media. The closer this type is to its piscine origin the more it has the avain aspect; the farther away it is and the longer it has been cultivated at 36° C., the more it is like the human.

One of these authors, by starting with the *Bacillus tuberculosis piscium* and passing it through a series of guinea pigs, obtained a tuberculosis which differed in nothing from the human in its cultural, morphologic, and pathogenic characteristics.

Herzog[8] in a recent publication concludes from his experiments that the bacillus of mammalian tuberculosis loses its power to infect mammals when it is passed through the organism of cold-blooded animals. The longer mammalian bacilli are allowed to remain in the body of the frog the longer do guinea pigs live after they are inoculated with these bacilli. He says that Dieudonné was even more successful in similar experiments conducted by him. He found that of frogs inoculated directly with mammalian tuberculosis almost all survive; of the frogs inoculated from this first set of frogs a few die, the majority survive; while of the third group of frogs inoculated from the second group the majority die; a part survive. The bacilli are found to have undergone a great change morphologically; they are short and broad and hardly to be distinguished from those of fish tuberculosis. The cul-

tures, too, are very similar to the cultures of fish tuberculosis and would only grow between 22° and 30° C. Attempts to obtain cultures at the maximum temperature mentioned had been unsuccessful up to the time of reporting. The bacillus was no longer pathogenic for guinea pigs.

Friedmann[20] also found that the turtle bacillus, when inoculated in guinea pigs in large doses, produced true tubercles containing both giant cells and tubercle bacilli.

Comparative studies of human and bovine bacilli have been made by numerous investigators. In a recent article Wolbach and Ernst[24] state with reference to their work:

> Rarely in the human cultures exceedingly large, round bodies, several microns in diameter were found in branched bacilli at the point of junction of the three branches; still more rarely the center of this body was occupied by a round, unstained refractive body, such as has been described by Fischel in the club swellings of the avian bacillus.
>
> With the exception of the last-described forms, which undoubtedly are degenerate, all those found in the human cultures were found in the bovine cultures, although with less frequency. Branched bacilli and the thread-like rods were found, while the small and large deeply staining spore-like bodies were found in as great abundance as in the human cultures. In the cultures isolated by ourselves the average lengths were less than in the human cultures, rarely exceeding 6 to 8 μ in length. In the bovine culture from Král exceedingly long thread-like forms were found.
>
> Remarkable as the changes described seem when we compare the two extremes, one the short rods averaging about 1 μ in length occurring on egg, the other the long filiform and branched bacilli 10 to 15 μ long occurring on brain, yet they are constant in their occurrence, and one extreme may be changed into the other at once by change of medium.

In their summary these authors say:

> (1) The tubercle bacillus undergoes marked changes in morphology with change of culture medium. (2) The microscopic characteristics of a fully developed culture are fairly constant for each medium.

The rapidity with which the morphology of the tubercle bacillus changes when the cultures are made on different media indicate that it is possible to lay too much stress on the appearance of the rods as indicative of different types. As the body of an infected animal is simply a culture medium for the inoculated bacilli, we should infer from the laboratory experiments just mentioned that bacilli from the same culture if introduced into the bodies of animals of different species might in each case develop different morphological characters. For this reason the morphology can not be regarded as a very satisfactory means of distinguishing between tubercle bacilli from different sources. Indeed, in the same microscopic preparation we generally find both long and short rods, and it is sometimes difficult to say of which there are the most or what is the average length. I have recently been shown a photograph by de Schweinitz of two microscopic shreds from the same culture, one of which was made up entirely of short rods and the other entirely of long rods. Now, as the

bacilli in each of these shreds appeared to reproduce their individual characteristics, it is quite likely that a culture made from one shred would have a very different appearance from that made from the other shred, so far as relates to the morphology of the rods.

About two years ago, in order to study the changes which occur in tubercle bacilli grown under different conditions, I requested Schroeder to carefully inject some human tubercle bacilli into the udder of a dry cow. He therefore, on October 3, 1901, injected 40 c. c. of virulent human culture through the duct of the teat, using a blunt canula and observing every precaution to prevent mechanical injury. This injection was followed by considerable swelling and induration of the affected quarter of the udder, and by the secretion of 300 to 400 c. c. of a gray sirupy fluid having a glistening appearance, in which were found numerous leucocytes, fat globules, and tubercle bacilli. There is still at this time (January, 1904) some induration of the udder, and the secretion containing tubercle bacilli has continued since the time of infection. It is quite remarkable that this human bacillus, which is not pathogenic for bovine animals, should have been able to maintain its existence and to multiply within the milk ducts of the cow for so long a period of time. The virulence of the bacilli have been tested from time to time, but no material change in this respect has been demonstrated. Cultures on egg medium recently examined show that the colonies are easily broken up and in this character resemble bovine cultures, but otherwise no change has been observed.

Ravenel[25] infected a calf with a human culture of moderate virulence by administering large and repeated doses. The animal lived one hundred and six days, and at the autopsy showed tubercles in the bronchial glands, liver, omentum, mesentery, and lungs. A second calf, inoculated from the first, died in forty-eight days. A third calf, inoculated from the second, died in twenty-three days, while the fourth and fifth of the series each died in twenty-four days. The author believes not only that he succeeded in conveying human tuberculosis to calves by giving large and repeated doses of the culture, but by successive passages through calves there was brought about a marked increase in the virulence of this culture.

Theobald Smith,[21] in commenting upon this experiment, says:

I am not prepared to accept this single experiment as establishing the possibility of an increase in virulence of the human variety of bacilli in cattle. In spite of all precautions errors may creep in when a species eminently susceptible to the bovine bacillus is used, when the experiment extends over such a long period and so much culture fluid is injected that freedom from errors can only be established by several concordant results. On the other hand, it is conceivable that in such an experiment, indicating sudden increase in virulence, the culture used may have been originally a bovine culture grafted upon the human subject and thereby attenuated. Such a culture would probably respond quickly to serial inoculations, whereas a true human type may not.

It is difficult to see why the increase of virulence in the human culture growing in the bovine body is any more improbable than the decrease of virulence of the bovine bacilli growing in the human body. Both hypotheses involve a marked variation of virulence, and such a variation is probably as likely to occur in one direction as in the other.

Hamilton and Young[26] made a similar experiment, from which they conclude "that when tuberculosis from a human source has been ingrafted upon a calf, it gains enormously in virulence by being reinoculated upon a second calf."

Arloing[15] states that in the course of his investigations in 1884 and 1886 he increased the virulence of the material (tubercular) from certain surgical lesions by several successive passages through the guinea pig. In a certain number of cases this material, which at first infected only the guinea pig, finally became infectious for the rabbit. The most profound changes which he obtained were those which resulted from accustoming the bacilli to vegetate in the deeper layers of glycerin bouillon. The human bacillus, which before being accustomed to the bouillon produced tuberculosis in the rabbit and guinea pig by all the channels of inoculation, now presented special characteristics. It infected guinea pigs only with great difficulty and very feebly by subcutaneous inoculation, and appeared to be without effect upon the rabbit when introduced by the same channel. Injected into the rabbit intravenously, however, it produced a kind of septicemic tubercular infection, fatal in two or three weeks, without apparent tubercular lesions in the lungs—one might believe it dispossessed of its tubercle-producing power—but if introduced into the peritoneal cavity of the rabbit in proper dose, it caused an extensive tubercular eruption on the omentum and on points of the mesentery and intestinal folds. If propagated for a long time in bouillon by successive cultures, it may, without known cause, recover a small part of its old virulence and cause an eruption of very discrete and very small tubercles in the lungs.

The intravenous injection of this bacillus with calves does not give rise to the same appearances; but the effects are no less remarkable. In fact, these inoculations determine very extensive infiltrations of the lungs, which cause death in a few weeks.

A bovine bacillus of normal virulence was also accustomed to grow in the deeper parts of glycerin bouillon, and after a few generations in this medium its virulence became modified. It was still very fatal for sheep and goats, but had become remarkably harmless for calves. The lesions which it caused in the lungs were also modified. In place of the usual granular eruption, it produced with sheep and goats massive lobular infiltrations scattered here and there in the lungs, having a gray color and a sarcomatous appearance on section.

A very interesting experiment has recently been made by Mohler,[27]

in the Bureau of Animal Industry. Two cows, Nos. 300 and 312, were inoculated subcutaneously with tubercle bacilli obtained from human sputum. After testing with tuberculin, the inoculations were made by the injection in front of each shoulder of 2 c. c. of normal salt solution containing tubercle bacilli in suspension. One of the animals (No. 300) received in this manner bacilli which had been cultivated artificially for five generations upon dog serum, without passage through any intermediate animal other than the guinea pig first used to isolate the bacillus from contaminating organisms in the sputum. The other cow (No. 312) was inoculated with material from the same source originally, but, instead of continued growth in the incubator upon dog serum, it had been passed successively through a series of seven rabbits. An emulsion of the axillary gland of the last rabbit was used for the injection. The rabbits succumbed upon the eighty-second, thirty-third, fiftieth, twenty-first, fifty-eighth, thirty-fifth, and thirty-sixth days, respectively, after inoculation—an average of forty-six and one-half days.

As a result of this comparative test it was shown at the autopsy of these cattle, held, respectively, one hundred and fifty-eight and one hundred and fifty-nine days after inoculation (both animals having been chloroformed), that the bacillus in the first instance had failed to produce any lasting tubercular lesion whatever, the autopsy being absolutely negative. The lesions present in the second animal, however, indicated that marked increase in virulence had occurred from the repeated passage of the tubercle bacillus through rabbits.

The clinical notes show that the animal's temperature had risen from an initial of 102° to 106° F. on the fourteenth day after inoculation, and that acceleration of respiration was noticeable. The temperature gradually receded, although it was variable from day to day. Later observations showed that there was at each point of inoculation a firm, hard tumor involving the adjacent prescapular gland. The autopsy showed on the right side at the point of inoculation a tumor the size of a hickory nut, full of thick yellowish pus. At the opposite seat of injection there was a tumor the size of a hen's egg, full of caseous material and surrounded by an inflammatory area of granulation tissue. The right and left prescapular glands were enlarged and contained numerous foci of calcareous matter. The lungs contained twelve or more scattered grayish tubercular foci. The anterior and posterior mediastinal lymph glands were greatly enlarged and thickly studded with calcareous tubercular areas. The bronchial glands were the size of pigeon eggs and gritty on section. The liver contained some fifteen tubercular foci, both superficial and deep. The retropharyngeal, submaxillary, prepectoral, and portal lymph glands all contained small tubercular foci, and there were inflammatory fibrous neoplasms on the costal and diaphragmatic pleura and the omentum.

We have here a case of tuberculosis in a bovine animal produced

by sputum bacilli, and the virulence of these sputum bacilli had been increased by passage through a series of rabbits, since other bacilli from the same source which had not been passed through rabbits failed to produce any disease when similarly inoculated upon a bovine animal.

Mohler has made similar studies with another culture of bacilli which were obtained from the human subject, but which had morphological and cultural peculiarities similar to those of the bovine bacillus, although it produced in cattle local lesions only. This bacillus was passed through a series of five cats, and was then found to be completely changed in its morphological appearance, the rods being elongated, slender, more or less beaded, and entirely of the human type. But far from decreasing in virulence, as might be expected from its morphological appearance, this bacillus had so increased in its pathogenic activity that it now produced generalized tuberculosis in a cow. This cow was inoculated subcutaneously in front of each shoulder with 2 c. c. of a salt solution emulsion of the tuberculous omentum of the last cat of the series. The cow rapidly lost flesh, had a temperature of 104° F., with the point of inoculation and adjacent glands greatly swollen. The autopsy revealed generalized tuberculosis, involving the lungs, mediastinal glands, spleen, liver, and kidneys.

Other cultures of the tubercle bacillus obtained from the mesenteric glands of a sheep, hog, and cow, when recovered from their original source and grown on dog serum, conformed to the bovine type in every particular; but after passage through several cats and recovery on dog serum a striking change was observed in their morphology, since they then showed elongated and slender rods more or less beaded and undistinguishable from the human bacillus. That there was no decrease in the virulence is indicated by the fact that the last cat in the series succumbed in a shorter period of time than the most of the cats in the same series and always in less time than the average duration of life shown by the preceding animals of the series.

THE SIGNIFICANCE OF TYPES AMONG TUBERCLE BACILLI.

The successful results of experiments made with a view of modifying the virulence of tubercle bacilli obtained from different sources and having different degrees of activity are now so numerous, so positive, and so concordant that it is impossible to explain them away by the hypothesis of accidental contamination or by the suggestion that the cultures used had an origin different from what was supposed. Beginning with reciprocal transformations of the avian, mammalian, piscine, and amphibian bacilli, investigators have attacked the types which are less clearly defined, such as the human and the bovine types, and have both reduced and increased their virulence for certain species of animals and have modified their morphological appearance to such an extent that it is no longer possible to identify them by their form.

What, then, is the significance of the word "type" as applied to tubercle bacilli of human, bovine, porcine, or canine origin? Is it not merely an aggregation of temporary characteristics which have been acquired as the result of the vegetation of the bacillus for a time under certain definite conditions of environment?

When the differentiation of human and bovine bacilli was first undertaken the characteristic made most prominent was the much greater virulence for cattle of bacilli of bovine origin. It has since been proven, however, that bacilli equal in virulence to those of bovine origin have been obtained from the human subject, and it has also been proven that bacilli of no greater virulence than the average human bacillus have been obtained from the bovine subject. According to Kossel[18], the German tuberculosis commission recognized three degrees of virulence in seven cultures which they tested from cattle and hogs, and it also recognized four degrees of virulence in thirty-nine cultures from human sources. It is evident, therefore, that no specific degree of virulence can be defined as absolutely characteristic of either the human or the bovine bacillus. The most that we can say is that the greater part of the bovine bacilli are much more virulent for cattle, sheep, goats, rabbits, and perhaps some other animals, than are the greater part of the human bacilli. The investigations thus far made would seem to indicate that there are all gradations of virulence among tubercle bacilli of bovine origin as well as among those of human origin.

Another characteristic, which was named with considerable confidence as a distinguishing feature, was the morphological appearance of the rods when grown upon dog serum. Bacilli have been obtained from the human subject, however, which had the exact morphology that had been attributed to the bovine bacilli, and bovine bacilli have been changed by passing them through cats so that they acquired the morphology of the human bacilli. The length and breadth of the rods vary as they are found in the lesions of the same subject; bacilli of the same source vary greatly according to the medium upon which they are grown, and the individual rods of the same culture and growing upon the same medium also vary. While the greater part of the cultures from human sources which have been grown upon dog serum for a considerable time show rods which are longer and thinner than those of most cultures similarly made from bovine sources, there are notable exceptions to this rule.

Of the cultural characteristics about the same thing may be said. The most of them are far from constant, as may be noted, especially if we compare a number of bovine cultures and a number of human cultures each from a different subject. The reaction test of the culture medium which has recently been proposed has not been investigated sufficiently to enable one to form an opinion as to its accuracy.

There appears, a priori, to be no more reason to expect constancy in this character than in the others which have been suggested as a means of discriminating between bacilli from different sources.

It is undoubtedly true that tubercle bacilli tend to the production of different types corresponding to the medium upon or within which they are grown and to the conditions of environment to which they are subjected, and it is therefore to be expected that vegetating in any given animal species for a time they will present some special characteristics. These characteristics may be valuable in many cases as indicating the origin of a given culture, but they can not be properly regarded as fixed and unchangeable nor as indicating that such types are pathogenic only for the particular species of animal from which the type was obtained.

THE TRANSMISSION OF ANIMAL TUBERCULOSIS TO MAN.

Basing their conclusions upon the failure of the inoculations made by them to produce tuberculosis in bovine and other large animals with cultures of the human bacillus and upon the morphological and cultural differences above referred to, some investigators have held that human tuberculosis differs from bovine and can not be transmitted to cattle, and that, on the other hand, it is doubtful if bovine tuberculosis can be transmitted to man. In order to reach these conclusions it was necessary to ignore the very positive results of Chauveau[28] in infecting cattle with human tuberculosis and those of other experimenters who produced less extensive lesions in the inoculated animals. It was also necessary to put aside the clinical evidence of the infection of man with bovine tuberculosis, which, while not absolutely conclusive, was yet very strong, particularly the cases of accidental inoculations. And, finally, it would appear that the successful inoculations of mammalian tuberculosis upon birds, fishes, and amphibians, and the counter inoculations of avian, piscine, and amphibian tuberculosis upon mammals, had been lost sight of, or the authors in question would have been more cautious in putting forth such hypotheses, for surely if the disease was transmissible between such widely separated species as human and carp it would be hard to believe that it could not be transmitted from human to bovine.

Since Koch's paper was read before the British congress on "Tuberculosis in 1901" numerous investigators have taken up this question, and it has been shown conclusively that tubercle bacilli from the human subject may be so virulent as to produce generalized tuberculosis in cattle, even when inoculated subcutaneously. It is not necessary for me to enter into details concerning the various experiments conducted by Vagedes, Ravenel, de Schweinitz, Mohler, De Jong, Delépine, Stenström, Fibiger and Jensen, Nocard, Max Wolff, Arloing, Behring,

Dean and Todd, Hamilton and Young, the German Tuberculosis Commission, and by Theobald Smith, all of whom have succeeded in causing generalized tuberculosis in cattle by inoculation with bacilli of human origin. The German commission in testing thirty-nine human cultures found four of these to be very virulent for cattle, which is approximately 10 per cent; but all of these cultures were included in the sixteen which were obtained from children, so that of the cultures from children tested 25 per cent were virulent for cattle. The experiments of the above-mentioned investigators at once and forever disprove the conclusion that tuberculosis can not be transmitted from the human subject to cattle; but the question has been raised as to whether this virulent tuberculosis obtained from man is really of human origin or whether it is bovine tuberculosis which has been grafted upon the human subject. If it be admitted that this is human tuberculosis, then it follows that cattle are susceptible to human tuberculosis, and the principal argument that has been used to show that bovine tuberculosis is not communicated to man falls to the ground. If, on the other hand, it be admitted that the subjects from which these virulent cultures were obtained were affected with bovine tuberculosis, then it follows without further argument that the tuberculosis of animals is an important factor in the causation of human tuberculosis.

It has been my object to impress upon you, so far as I could in the brief time at my disposal, how widely the disease which we know as tuberculosis is distributed in nature; how it has been observed in fishes, frogs, lizards, snakes, turtles, birds, and in a great variety of mammals; how it may be transmitted artificially from any one of these creatures to another far removed from it in the zoological scale; how the morphology and cultural characteristics of the bacilli from these different sources, though in many respects they show great variations, may be modified almost at the will of the experimenter by gradual adaptation to other animal organisms or to other conditions of environment; how different degrees of virulence and different morphological characteristics have been found which form a series of intermediate grades between the most virulent bovine bacilli and the most attenuated human bacilli; how the virulence of bacilli from human sources has been increased by passage through rabbits, cats, and calves until in each case it became very active for bovine animals, and how the test of inoculating bovine animals with bacilli from human sources has shown that a considerable proportion of such bacilli produce generalized tuberculosis in these animals, and thus exhibit a virulence which is not to be distinguished from that of tubercle bacilli from bovine sources. As a result of all this work we are looking at tuberculosis more and more from the point of view of general pathology; in other words, we are taking a broader view of

these questions, and the little barriers which were raised to form a dividing line between human and bovine tuberculosis are melting away. We see one tuberculosis, one tubercle bacillus with infinite variations according to its habitat, whether that habitat is an artificial culture medium or an animal organism; and, notwithstanding these variations, a bacillus which is always essentially the same, and one which may at any time, if given suitable conditions, retrace its steps and recover the properties which it possessed before the variations occurred.

Now, a word as to the practical lessons which we should obtain from these scientific investigations. A great and successful effort is being made to reduce the suffering and mortality which results from human tuberculosis. Rooms occupied by consumptives are disinfected, the sputum is destroyed, expectoration in public places and on the sidewalks is prohibited, sanatoria are being established where those afflicted with the disease may be properly treated without endangering other members of the community. And so one by one the channels of infection between man and man are being brought under control or abolished. The good effects of this work are already seen in the reduction of the mortality from tuberculosis in the places where it has been going on. But why should we ignore the channels of infection between animals and man? There is a tremendous amount of tuberculosis in cattle, particularly in milch cows, and in pigs; and the frequency of the disease in these animals is increasing from year to year. Why should we continue to allow milk to be sold and to use it ourselves if it is produced by herds where 50 to 90 per cent of the cows have tuberculosis? Why should we continue to allow tuberculous animals to be slaughtered practically without supervision in numerous abattoirs and the meat sold for human consumption without restriction?

There are two answers to these questions. The first is that the work is progressing along the lines of least resistance, and the second is that the medical profession has never appreciated, and does not now appreciate, the importance of animal tuberculosis as a factor in the production of human tuberculosis. This fact is as plain as the noonday sun to anyone who has watched the development of medical sentiment, as I have, for nearly a third of a century. When the experiments of Villemin[29] demonstrated the infectiousness of tuberculosis, and veterinarians called attention to the danger of infection from animal sources, some twenty-five years ago, we were told that tuberculosis was plainly an hereditary disease, and that if it was infectious from man to man or from animals to man there would be plenty of clinical evidence to that effect. But time ran on, the bacillus tuberculosis was discovered, and the profession reversed its theory that tuberculosis was exclusively the result of hereditary influence. It was soon seen that the problem

of controlling this disease, which before had been hopeless, was now comparatively plain, at least so far as principles of administration were concerned. And there were many who wondered why it had taken so long to discover clinical evidence demonstrating the infectiousness of the disease between man and man, when such cases had been occurring everywhere in abundance from time immemorial.

There has been almost to the present moment just as strong a prejudice against the theory of infection from animal sources as there was formerly against the theory of infection from human sources. Clinical evidence indicating infection from animals has been ignored, explained away, or summarily rejected, just as similar evidence as to infection from man to man was disposed of before the discovery of the tubercle bacillus. And as the evidence of infection from animals multiplied, and could be no longer entirely ignored, the attempt was made to neutralize it or hold it in check by the erection of scientific barriers. The promulgation of the idea that human tuberculosis was not transmissible to cattle and that human and bovine bacilli were distinct types with well-defined characteristics started this movement, which culminated at London in 1901 with Koch's[30] memorable address before the British Congress on Tuberculosis. In that address he took the most radical position in advocating the difference between human and bovine tuberculosis and the improbability of the transmission of the disease from animals to man. Since that time, as has already been shown, the conclusions from his experiments have been demonstrated to be incorrect, the disease has been again and again transferred from man to animals, and bacilli of the bovine type have been frequently found in the lesions of the human subject. What are we going to do now? Shall we try to find some other reasons for neglecting our plain duty in this matter, or shall we try to control this source of infection as well as the other sources?

The frequent infection of the human subject with animal tuberculosis appears to be established by the scientific investigations to which reference has been made. It is notable that most of the cases having bacilli of the bovine type have occurred in children. Each of these cases forms a new center of tuberculosis infection, and it is to be remarked that these bacilli of the bovine type are pathologically very active; they are more virulent for most animals, and probably more virulent for man than are the bacilli of the human type. Therefore it appears that these new centers of tuberculosis may be the means of keeping up the activity and virulence of the disease in man. It is a striking fact that human bacilli are generally much more saprophytic in their characters and far less virulent than those from most other mammalian sources, and it seems that the human organism has the power of attenuating these bacilli and gradually making them less and less

harmful; but this influence for good must be continually counteracted by the infusion of extremely pathogenic germs from animal sources.

It is not my purpose to discourage in the least any of the efforts being made or contemplated for limiting the danger of infection from the tuberculous human patient, but I insist that it is also the sanitarian's duty to guard against infection from tuberculous animals.

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BOVINE TUBERCULOSIS AFFECTING THE PUBLIC HEALTH.[a]

By D. E. Salmon, D. V. M.,

Chief of the Bureau of Animal Industry and Chairman of the Committee on Animal Diseases and Animal Food of the American Public Health Association.

Your committee on animal diseases and animal food have the honor to make the following report with reference to tuberculosis, and regret that the time at the chairman's disposal has not permitted the inclusion of other subjects which are also of great interest at this time.

In the last two reports presented by this committee considerable space was devoted to the subject of tuberculosis, and particularly to that phase of it which relates to the transmission of the disease from animals to man. It was shown from a review of the facts obtained by different methods of inquiry that the clinical evidence, the evidence of statistics, and the evidence from experimental researches all favored the conclusion that animal tuberculosis was a factor in the causation of human tuberculosis, and it was held that sanitarians should advocate and enforce measures to prevent the transmission of the disease from animals to man. This question is so important and so much uncertainty has been caused by the paper presented at the British Congress on Tuberculosis by Koch,[1] [b] and by his subsequent address at the International Conference on Tuberculosis at Berlin, that it is deemed advisable to continue the discussion in the present report.

The fact that tubercular material from human subjects often failed to produce serious disease in cattle was observed by a number of the earlier investigators who experimented with such virus. It was the experiments and comparative studies of Theobald Smith, however, which attracted special attention to the difference in virulence shown by tubercle bacilli from human and bovine sources when inoculated upon cattle. Smith[2] mentioned also certain morphological and cultural differences in bacilli from these two sources and in the location and histology of the lesions in cattle produced by such bacilli. He

[a] Report of committee on animal diseases and animal food to the American Public Health Association, at Washington, D. C., October 26–30, 1903. Published also in Bul. No. 53, pp. 51–60, of this Bureau.

[b] Figures refer to bibliography at end of article.

did not conclude, however, that bovine bacilli could not produce disease in the human subject, but said:

> It seems to me that, accepting the clinical evidence on hand, bovine tuberculosis may be transmitted to children when the body is overpowered by large numbers of bacilli, as in udder tuberculosis, or when certain unknown favorable conditions exist.

Koch, however, in his address at the British Congress on Tuberculosis, went far beyond this and maintained that "human tuberculosis differs from bovine, and can not be transmitted to cattle." As to the susceptibility of man to bovine tuberculosis, he said it was not yet absolutely decided, but one was "nevertheless already at liberty to say that, if such a susceptibility really exists, the infection of human beings is but a very rare occurrence." He emphasized this view in the following language:

> I should estimate the extent of infection by the milk and flesh of tubercular cattle and the butter made of their milk as hardly greater than that of hereditary transmission, and I therefore do not deem it advisable to take any measures against it.

This conclusion was so radically different from the views of most experimenters and so out of harmony with facts which had apparently been demonstrated by others, that it at once aroused opposition in the congress, followed by the adoption of dissenting resolutions, and led to numerous investigations in various countries. Koch's conclusions were based upon his failure to produce tuberculosis in cattle and other animals by inoculating them with tubercular material of human origin, and his success in causing progressive and fatal tuberculosis in the same kinds of animals when inoculated with tubercular material of bovine origin. With such positiveness did he hold to the constant and specific difference between the human and bovine bacillus that he promulgated an experimental method of discriminating between them. Speaking of the etiology of intestinal tuberculosis in man, he said:

> Hitherto nobody could decide with certainty in such a case whether the tuberculosis of the intestine was of human or of animal origin. Now we can diagnose them. All that is necessary is to cultivate in pure culture the tubercle bacilli found in the tubercular material, and to ascertain whether they belong to bovine tuberculosis by inoculating cattle with them. For this purpose I recommend subcutaneous injection, which yields quite specially characteristic and convincing results.

These important and comprehensive conclusions followed from a comparatively few experiments upon animals, and apparently no effort had been made to learn to what extent human tubercle bacilli might differ in their virulence for cattle or what grades of virulence there might be among bacilli of bovine origin. Vagedes had already shown that bacilli were sometimes present in human lesions which were as virulent as bovine bacilli, but his work was wholly ignored by Koch. In the preceding report of this committee reference was made to the work of Ravenel, de Schweinitz, Mohler, de Jong, Delépine, Orth,

Stenström, Fibiger and Jensen, Max Wolff, Nocard, Arloing, Behring, and Dean and Todd, all of whom found tubercle bacilli in human lesions which proved to have about the same virulence for cattle and other animals as had the bacilli from bovine animals affected with tuberculosis. Since that report was presented, Theobald Smith has reported the finding of a human bacillus virulent for cattle, and there has been made a preliminary announcement by Kossel of the results obtained by the German tuberculosis commission. The statement of Kossel should receive the most careful consideration, coming from a commission appointed upon Koch's recommendation and evidently inclined to favor his views so far as possible in its report.

Kossel[3] stated that the commission had tested 7 cultures of tuberculosis from cattle and hogs—4 from cattle and 3 from hogs. Two of these cultures proved acutely fatal in cattle after eight to nine weeks; 4 of the cultures likewise produced a generalized tuberculosis, but which certainly had a more chronic course; while 1 of the cultures caused only an infiltration at the point of inoculation, with some caseous foci in the adjoining prescapular gland and in one of the mediastinal glands, and there was lacking the spreading of the tuberculosis over the entire body, which they were accustomed to see after the injection of cultures of bovine tuberculosis. "Hence," says Kossel, "among bovine tuberculosis bacilli there can also occur differences with regard to the virulence."

The German commission also tested 39 different freshly made cultures from tuberculous disease in man. Nineteen of these cultures did not produce the slightest symptoms in cattle; with 9 others the cattle exhibited after four months very minute foci in the prescapular glands, which were mostly encapsuled and showed no inclination to progress; with 7 other cases there was somewhat more marked disease of the prescapular glands, but it did not go so far as a material spreading of the process to the glands next adjoining; there were 4 cultures, however, which were more virulent and caused generalized tuberculosis in the cattle inoculated with them.

It would appear, therefore, that hereafter even Koch must admit that it is impossible always to tell the source of a culture of the tubercle bacillus by its effects when it is inoculated upon cattle. One of the bovine cultures failed to produce generalized tuberculosis in cattle, and some of the human cultures did produce this form of the disease in such animals. Moreover, while some of the human cultures caused no disease at all, others led to the development of minute foci in the prescapular glands, and still others to somewhat more marked disease of these glands. There were, consequently, four degrees of virulence noted in these 39 cultures of bacilli from human sources and three degrees of virulence in the 7 cultures from animal sources.

Now, if we accept the views of Koch as to the specific difference

between human and bovine tubercle bacilli, and that the human bacilli produce only localized lesions in cattle, while bovine bacilli produce generalized lesions in these animals, must we not conclude that the one nonvirulent bovine culture was in reality of human origin, and that the animal from which it was obtained had been infected from man? This is a logical deduction, but reverses the dictum laid down at London that human tuberculosis is not transmissible to cattle. Again, how are we to explain the human cultures of medium virulence? Are they human bacilli which, for some unknown reason, are increasing in virulence and approaching the activity of the bovine bacillus? Or are they really bovine bacilli which have multiplied in the human body until their virulence has become attenuated? In whatever manner these questions are decided, it would seem that the findings of the German commission, instead of supporting Koch's views that we can decide with certainty by the inoculation of cattle as to the source of any given bacillus, really show that this method of diagnosis is extremely uncertain in the present condition of our knowledge.

It is definitely admitted that 4 of the human cultures caused generalized tuberculosis in cattle; but Kossel suggests that it might be possible that the bacilli in cases of human tuberculosis under certain circumstances could likewise attain a very high pathogenic activity for cattle without being for that reason bovine bacilli. Undoubtedly the German commission is confronting the two horns of a dilemma, either one of which is fatal to the views of Koch as stated with such positiveness at London. If we accept this suggestion thrown out by Kossel, we must conclude that Koch was wrong in his claim that human tuberculosis can not be transmitted to cattle, and thus with one blow we destroy the entire experimental support which he had for his argument before the British Congress on Tuberculosis. And if, on the other hand, we accept the conclusion which follows from the principle laid down by Koch for the discrimination between human and bovine bacilli, and which appears to be favored by Kossel, we must admit that bovine tuberculosis is an extremely important factor in the etiology of human tuberculosis. Of the 39 cases of human tuberculosis tested, 4, or over 10 per cent, were virulent for cattle and would be classified as of bovine origin; but these 4 cases were all found among the 16 cases of tuberculosis in children which the commission investigated; hence it is plain that 25 per cent of the cases tested of tuberculosis in children would by Koch's method be classified as of bovine origin.

In the Bureau of Animal Industry two distinct lines of experiments have been carried on, in order that one might serve as a check against the other. There has been, however, no discrepancy in the results. De Schweinitz,[4] in the Biochemic Division, Bureau of Animal Industry, has isolated 9 cultures from human tuberculosis. Two of these

were derived from human sputum, 3 from cases of generalized tuberculosis in adults, and 4 from cases of generalized tuberculosis in children. By comparing these cultures with a newly isolated virulent culture of bovine tuberculosis, there were found among them 2 cultures from children which were identical in their cultural and morphological characters with the bovine bacillus. These cultures also killed rabbits and guinea pigs in as short a time as did the bovine bacillus. Hogs which were inoculated subcutaneously with these 2 cultures from children died of generalized tuberculosis. Two calves, weighing over 300 pounds each, were inoculated subcutaneously with these virulent human cultures, and as a result developed generalized tuberculosis. A yearling heifer inoculated with 1 of the cultures showed generalized tuberculosis when killed three months after inoculation. Both the cattle and the hogs had been tested with tuberculin and found to be free from tuberculosis before the inoculations were made. It is important to observe in this connection that 2 out of 4, or 50 per cent, of the cultures obtained from cases of generalized tuberculosis in children proved virulent for cattle.

Mohler,[5] working in the Pathological Division, Bureau of Animal Industry, has obtained 3 very virulent cultures of tubercle bacilli from the human subject. A goat inoculated subcutaneously with one of these cultures died in thirty-seven days with miliary tuberculosis of the lungs involving the axillary and prescapular glands. This bacillus was obtained from the mesenteric gland of a boy. Of still greater interest is a bacillus isolated by Mohler from human sputum. A goat inoculated subcutaneously with a culture of this germ died in ninety-five days of pulmonary tuberculosis. A cat inoculated in the same manner died in twenty-three days of generalized tuberculosis. A rabbit similarly inoculated died in fifty-nine days of pulmonary tuberculosis. Another rabbit inoculated with a bovine culture for comparison lived ten days longer than the one inoculated with this sputum germ. Mohler also inoculated subcutaneously a 1-year-old heifer with a culture derived from the tubercular mesenteric gland of a boy 4 years of age. This culture was always refractory in its growth under artificial conditions, and the bacilli were short, stubby rods corresponding in appearance with the bovine type. At the autopsy, held one hundred and twenty-seven days after the inoculation, the general condition was seen to be poor and unthrifty, and large, hard tumors were found at the points of inoculation. On the right side the swelling measured 3½ by 5 inches, and the corresponding lymph gland was 2¾ inches long by 1¾ inches in diameter. This gland contained numerous calcareous foci; one of these at the apex was an inch in diameter. The lesions on the left shoulder of the animal were very similar to those found on the right side, but the dimensions of the tumor were slightly less. The lungs presented an irregular mass of tubercular nodules, and 7

or 8 grape-like nodules were seen on the parietal pleura. Bronchial and mediastinal lymph glands contained numerous tubercular foci, and the pericardium, peritoneum, spleen, and liver were also affected.

In order to throw some light, if possible, upon the morphological constancy of the different types of tubercle bacilli, Mohler was requested by the chairman of your committee to make comparative studies of bacilli from various sources, and which had been passed through various species of animals, by making the cultures upon dog serum after the method described by Theobald Smith. Some important results have been obtained. One culture of human bacilli which had morphological and cultural peculiarities similar to those of the bovine bacillus, and which only produced local lesions in cattle, was passed through a series of 5 cats. It was then found to be completely changed in its morphological characters, the rods being elongated, slender, more or less beaded, and entirely of the human type. But, far from decreasing in virulence, as might be expected from its morphological appearance, this bacillus had so increased in its pathogenic activity that it now produced generalized tuberculosis in a cow. This cow was inoculated subcutaneously in front of each shoulder with 2 c. c. of a salt solution emulsion of the tubercular omentum of the last cat of the series. The cow rapidly lost flesh; had a temperature of 104° F., with the point of inoculation and adjacent glands greatly swollen. The autopsy revealed generalized tuberculosis, involving the lungs, mediastinal glands, spleen, liver, and kidneys. Tubercle bacilli of the bovine type obtained from the mesenteric glands of a sheep, hog, and cow were similarly transformed in their morphological appearance after being passed through a series of cats and recovered on dog serum. These bacilli also increased in virulence, as the last cat in the series invariably succumbed in a shorter time than the first of the series.

These experiments and observations indicate that the types of tubercle bacilli are very inconstant, and that under suitable conditions they readily change both in morphology and in virulence. A similar conclusion was reached by other investigators in working with the avian and piscine types of tubercle bacilli several years ago, and was reasonably to have been expected with the human and bovine types.

It must be plain to all, from these recent developments, that too much has been made of the slight differences in cultural characteristics, in morphology, and in virulence which have been observed in some cases in comparing the human and the bovine bacilli. The observations were interesting, and it was important that they should be followed up until their significance was made entirely clear; but it was an almost unpardonable error, from a sanitary point of view, to promulgate sweeping generalizations calculated to arrest and abolish important measures for preventing human tuberculosis before the

soundness of these generalizations had been established by a thorough course of experimentation.

When Koch said in the British Congress on Tuberculosis that he should estimate the extent of infection by the milk and flesh of tubercular cattle and the butter made of their milk as hardly greater than that of hereditary transmission, and that he therefore did not deem it advisable to take any measures against it, he went far beyond what was justified by any experiments or observations which he reported, and he did an immense amount of harm which will be manifested for years to come to those who endeavor to guard the human race from the dangers of animal tuberculosis. The researches to which your committee has alluded make these dangers more definite and certain than they have appeared before, and sanitarians should therefore most earnestly endeavor to counteract the erroneous and harmful impression which was made by Koch's address at London and his subsequent address at the International Conference on Tuberculosis at Berlin.

Now that the conclusions of the London address are shown to be incorrect and based on insufficient experimentation, it is well that some attention should be given to the Berlin address, in which certain rules were laid down for testing all clinical evidence before it can be accepted as indicating the transmission of tuberculosis from animals to man.

While your committee agrees that it is advisable to scrutinize clinical evidence as carefully as possible before it is accepted as influencing the decision of such an important question, consistency demands that we should accept clinical evidence bearing upon the transmission of bovine tuberculosis to man on the same terms that we accept evidence bearing upon the transmission of tuberculosis from man to man. For instance, Koch said in his London address, "So the only main source of the infection of tuberculosis is the sputum of consumptive patients." How does he know this? Has he any evidence to support this conclusion which will stand the requirements which he has laid down for those who oppose his views with reference to the transmission of animal tuberculosis to man? If so, this evidence has not yet been presented. Your committee believes that the principal source of tuberculosis in man is infection from other tuberculous human subjects, but it also believes that a considerable proportion of the cases of tuberculosis in man is due to infection from animal sources; and in weighing the evidence by which we are to fix more rigorously the relation which these two sources of infection bear to each other it is logical that we should apply the same rules of evidence in each case.

The rules which Koch formulated for testing the evidence as to bovine infection are given below, with such brief comments as your committee feels they deserve:

(1) Certain proof of tubercle, and, where possible, the primary focus must be supplied.

To this condition no objection is raised, but it should be remarked that the location of the primary focus, which is made so much of, is of little value in determining the origin of the infection. It has been clearly shown by various investigators, whose work has been referred to in the preceding reports of this committee, that tubercle bacilli may pass through the walls of the intestine without producing any lesion at the point of entrance, and that their first point of lodgment and multiplication may be the mesenteric glands, the liver, spleen, or even the lungs. On the other hand, Koch has told us that the location of the primary lesion in the intestine is of no significance, because human as well as animal bacilli may be swallowed and may be the cause of such lesions. It is therefore not at all apparent that this is an essential point.

(2) Other sources of infection must be excluded with certainty.

This condition appears to exclude all clinical evidence bearing upon the source of tubercular infection. How is it possible to prove that any given individual has not been exposed to the bacilli of human tuberculosis? And, for the same reason, how is it possible to prove that any given individual has not been exposed to the bacilli of animal tuberculosis? It may be said that this consumptive person had habitually been in a room with another consumptive patient and was infected from that patient; but how can you prove that this person never ate any tuberculous meat, never partook of any tuberculous milk, never ate any butter containing the tubercle bacillus, never had an opportunity to be indirectly infected from the hands of cooks or from table utensils which had been in contact with tuberculous meat, milk, or butter, and was never exposed to the infection scattered in so many ways by tuberculous animals? It is impossible to exclude with certainty all these sources of infection, and if we apply the condition under discussion to the evidence upon which Koch based the assertion that the main source of the infection of man is the sputum of consumptive patients we should find no part of it that would stand the test. Now, is it logical to accept clinical evidence as to the transmission of tuberculosis from man to man by one set of rules and to require an entirely different set of rules when considering evidence as to the transmission of the same disease from animals to man? Your committee is of the opinion that clinical evidence should be regarded as valuable in confirming experimental researches, or in indicating the probable facts where experimentation has been insufficient or is impossible, but that it is too much to expect that clinical evidence will be forthcoming as to the transmission of tuberculosis which will exclude all possible sources of error.

(3) In each case of alleged infection from milk affected with bovine tuberculosis the condition of the rest of the people who have taken the same milk should be borne in mind. These fellow-consumers form

to a certain extent a control experiment, and if of the numerous people who have drunk the suspected milk only a single one sickens, this weighs decidedly against the belief that this one person was infected by the common food.

This condition also is regarded by your committee as illogical and impossible of general application without discarding all clinical evidence upon this question. If we apply it to the alleged cases of sputum infection, we find it is seldom, indeed, that the disease in more than one person can be traced with any probability to the same tuberculous patient, although scores of persons may have been exposed to that patient. Most people who escape tuberculosis have nevertheless been exposed many times to tuberculous patients, but this is not sufficient reason for concluding that others have not contracted the disease by similar exposure. Tuberculosis is a disease which is communicated with such difficulty among people under ordinary conditions of life, by exposure either to diseased persons or to tuberculous food, develops so slowly, and varies so much in the period which elapses before symptoms are observed, that it is only very rarely that groups of cases are observed which even appear to have originated from the same source. And yet how erroneous it would be to exclude clinical evidence suggesting contagion because only one of those exposed to a certain consumptive patient had contracted the malady.

(4) The source of the milk should be attended to. Since in recent years it has become more and more evident that milk containing tubercle bacilli is yielded only by such cows as suffer from tuberculosis of the udders, the general statement that some one has drunk milk from a cow suffering from tuberculosis no longer suffices to prove to us that bovine tuberculosis bacilli have really reached his digestive organs. It must be from a cow with tuberculosis of the udder, and therefore a statement on this subject should not be wanting in a report on milk infection if it is said to be complete.

Your committee finds this statement of fact to be incorrect, since the tendency of recent investigations by competent persons is to make it more and more evident that cows with tuberculosis may yield milk containing tubercle bacilli when the udders present no signs of the disease. The argument is therefore antiquated. Of the many experiments that have been made to determine the proportion of tuberculous cows which yield infectious milk, the average results are about 15 per cent, while the cases of tuberculosis of the udder are about 2 per cent. In recent investigations made by Mohler, of the Bureau of Animal Industry, with 56 reacting cows, it was found that 12 of these, or 21.4 per cent, at one time or another during the experiment gave milk which contained virulent tubercle bacilli. Undoubtedly cows with tuberculosis of the udder yield milk containing a larger number of tuberculosis bacilli than do those in which the udder remains unaf-

fected, and are therefore more dangerous, but it has been clearly shown that other tuberculous cows may yield virulent milk.

So much for the conditions laid down by Koch for testing clinical evidence bearing upon the transmission of tuberculosis from animals to man. The effort to rule out all such evidence by applying impossible tests does not meet with our approval, but fortunately clinical evidence is no longer necessary for deciding the question. The subcutaneous injection of cattle with pure cultures of the tuberculosis bacillus from human sources, which, according to Koch, "yields quite specially characteristic and convincing results," has proved, in the hands of the German commission no less than in those of independent investigators, that bovine tuberculosis is communicable to man. It will require much work to decide with even approximate accuracy the proportion of human tuberculosis caused by animal infection; but the fact that 25 per cent of the cases in children investigated by the German commission, and 50 per cent of similar cases investigated by de Schweinitz, showed by this test that they were caused by animal infection is sufficient to convince us that measures should be taken and enforced at once to guard against infection from this source.

In concluding, your committee desires to express its appreciation of the prompt, intelligent, and indefatigable work of those scientific investigators who took up this question immediately after it was brought to the front at London, and in the comparatively short period of about two years have furnished the material for definitely settling it, so far as the principal contention is concerned.

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A CHEMICAL EXAMINATION OF VARIOUS TUBERCLE BACILLI.

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The preliminary work of Hammerschlag[1] [a] upon the substances contained in the bodies of tubercle bacilli which could be extracted with ether and alcohol, and the probable composition of the extracts so obtained, offered considerable material for speculation. Nothing further was done in this line, however, until we[2] reported investigations which we had made confirming the work of Hammerschlag indicating the presence of a large percentage of ether and alcohol soluble material in tubercle bacilli. By a chemical examination of these extracts we were also able to determine the presence of volatile fatty acids, together with other acids of the fatty series of which only the melting points were determined.

More recently Klebs[3] reported the presence of considerable fatty material in tubercle bacilli. Weyl[4] found that the fatty extract of tubercle bacilli was possessed of the same "acid fast" property that is exhibited by the bacilli themselves. Ruppel[5] claims to have isolated three different fatty substances from the tubercle bacilli. Several years after we had published our preliminary work Aronson[6] reported a chemical examination which he had made of the bodies of tubercle bacilli. In this article he claims that a very large proportion of the ether and alcohol soluble material consists of free fatty acids. This statement, however, is not entirely confirmed by our own work. Levene[7] has reported analyses of human tubercle bacilli which were grown upon the ordinary glycerine bouillon and upon a similar medium containing mannite. By these analyses he found a considerable variation in both the percentage of extractive material and in the percentage of ash obtained after burning. In a recent article Kresling[8] reviews the work of various authors relating to the chemical constitution of tubercle bacilli of human origin, and also reports the results of his own analyses. The order in which the several solvents were used was varied considerably. The percentage obtained, however, was in all cases approximately the same. The bacilli had been collected during a number of years and had been cultivated upon the ordinary glycerine bouillon containing sodium chloride and peptone. Kresling found that the chloroform extract, chloroform being the first extractive used, contained about 14 per cent of free fatty acid.

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[a] The numbers refer to the bibliography at the end of the article.

We have extended our studies in the examination of the bodies of tubercle bacilli to the following: (1) An attenuated bacillus of human origin, obtained originally through the courtesy of Dr. E. L. Trudeau, which had been derived from a man and passed through a guinea pig. This had been grown upon glycerinized bouillon for about one hundred and sixty generations. Although originally virulent for small animals, it had entirely lost its pathogenic properties for guinea pigs. (2) A virulent bacillus of human origin, obtained also from man, which had subsequently been grown for fifty generations upon glycerinized bouillon. This organism still retained its virulence and was capable of causing the death of guinea pigs in five or six weeks after subcutaneous injection of a small amount. (3) A virulent bōvine bacillus obtained originally from Dr. Theobald Smith, which was still virulent for small animals as well as for cattle. (4) A swine bacillus, obtained also through the kindness of Dr. Theobald Smith, virulent for small animals. (5) A tuberculosis bacillus from a horse, obtained from Doctor Ravenel, of Philadelphia, and regarded by him as originally of bovine origin, as the conditions indicated that the horse had contracted the disease from cattle. (6) An avian bacillus, the original culture of which was also obtained from Doctor Ravenel. The bovine, swine, horse, and avian bacilli had also been grown upon glycerinized bouillon for several years, without passage through an animal. In order to obtain a quantity of material sufficiently large to permit of the chemical analyses recorded below, it was necessary to grow these various organisms in quantity; and in order to make the analyses comparable, a uniform medium was used. Its preparation and composition can be seen from the following record, taken from the laboratory books in which records are kept of each lot of culture media prepared: Chopped meat 1 part, distilled water 2 parts, heated at 45° to 58° C. for three hours, strained, boiled, filtered, 1 per cent peptone and one-half of 1 per cent acid potassium phosphate added. Neutralized with sodium hydrate; boiled one hour, 7 per cent glycerine added, filtered; acidity about 10 c. c. N/10 sodium hydrate required to neutralize 100 c. c. beef broth, phenolphthalein being used as an indicator.

The cultures of the several tubercle bacilli made upon the medium above described were from two to four months old, and had been grown at a temperature of 37° to 38° C. The whole cultures were poured into perfectly clean, sterile flasks and heated for a few minutes to the boiling point. The bacilli were then allowed to settle and first washed by decantation (with hot water), then transferred to a folded filter and washed again with hot water so long as a reaction for phosphates was noted, when the filtrate was tested with silver nitrate. This same process was adopted for all the different cultures, the greatest care being used to avoid contamination with any foreign matter. The moist germs were carefully removed from the filter paper by means of a spatula and dried over sulphuric acid. They

were then broken up into pieces about the size of very small bird shot and dried to a constant weight at 60° C. in an oven with a vacuum of 26 inches. These dried bacilli served as the starting point for the extractions. They were extracted first with hot ether, then with hot alcohol, and last of all with hot chloroform, Knorr's extraction apparatus being used. In each case the extraction was continued as long as any material was dissolved, and the extracted substance was again dried to a constant weight before proceeding to use the next solvent. The time occupied in this operation with the different solvents was from four to five days each. The quantity of material extracted was determined by loss of weight, the germs used being first weighed in the tube and again after the different extractions had been completed. The error resulting from manipulation, therefore, was the minimum. Table I shows the results of duplicate determinations of the ether, alcohol, and chloroform extracts of the six varieties of tubercle bacilli examined.

TABLE I.—*Ether, alcohol, and chloroform extracts of tubercle bacilli.*

	Bovine bacilli.			Swine bacilli.			Horse bacilli.		
	1.	2.	Average.	1.	2.	Average.	1.	2.	Average.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Ether extract	17.74	17.66	17.70	13.69	11.43	12.56	22.90	23.87	23.38
Alcohol extract	....	8.13	8.13	....	7.83	7.83	8.18	8.18	8.18
Chloroform extract	....	.49	.49	....	.20	.20	.29	.12	.20
Total	....	26.28	26.32	....	19.46	20.59	31.37	32.17	31.76

	Avian bacilli.			Attenuated human bacilli.			Virulent human bacilli.		
	1.	2.	Average.	1.	2.	Average.	1.	2.	Average.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Ether extract	17.40	17.32	17.36	28.86	28.59	28.72	20.40	20.22	20.31
Alcohol extract	13.15	13.39	13.27	7.22	7.49	7.36	7.21	7.23	7.22
Chloroform extract	.04	....	.02	1.33	(1.33)	1.33	.48	(.48)	.48
Total	30.59	30.71	30.65	37.41	37.41	37.41	28.09	27.93	28.03

It will be noted that by far the highest percentage of ether extract is obtained from the attenuated human bacilli, and from the others in the following order: Horse bacilli, virulent human bacilli, bovine bacilli, avian bacilli, and swine bacilli. The percentage of ether extract obtained from the avian and bovine bacilli was about equal in amount. When we consider the alcohol extract the order is different. The highest percentage of alcohol extract is found in the avian bacilli, and the others in the following order: Horse, bovine, swine, and human bacilli, there being but little difference between the quantity of alcohol extract in the two varieties of human bacilli. The chloroform extract was hardly worth consideration, except in the case of the attenuated

human bacilli and in the case of the virulent human bacilli and the bovine bacilli. In these latter the percentage of chloroform extract appeared to be about the same. In the consideration of the totals of these various extracts we find the following order: The highest percentage in the attenuated human, the horse, avian, virulent human, bovine, and swine, following in the order named, as can be seen in Table I. This high percentage of total extractive matter in the attenuated human bacilli agrees fairly well with the percentage noted in our original work upon the human bacilli already referred to and reported in 1895.

The amount of material at our disposal was so small that it was found to be impracticable to undertake an extensive examination of the ether and alcoholic extracts of the various bacilli. We have, however, been able to determine the percentage of free fatty acid in these extracts. The results of these determinations are recorded in Table II. The free fatty acid was calculated from the acid value, which was determined by titration with N/10 sodium hydrate. The free acids were calculated in all instances as oleic, although we do not feel at all certain that the acid value is due to the presence of oleic acid. An examination of Table II will show that the highest acid value was found in the extracts from the virulent human, and from the others in the following order: Swine, attenuated human, avian, bovine, and horse tubercle bacilli.

TABLE II.—*Acid value of ether and alcohol extracts of tubercle bacilli.*

	Acid value.		Total acid value calculated on the sum of the ether and alcohol extract.	Free acids in alcohol and ether extracts.	
	Ether extract.	Alcohol extract.		Ether extract.	Alcohol extract.
				Per cent.	*Per cent.*
Bovine bacilli	9.43	20.40	12.90	4.74	10.25
Swine bacilli	8.02	23.45	13.97	4.03	11.78
Horse bacilli	9.36	18.47	11.46	4.70	9.28
Avian bacilli	13.00	13.11	13.04	6.53	6.59
Human bacilli (attenuated)	12.77	14.57	13.13	6.41	7.32
Human bacilli (virulent)	14.02	16.45	14.63	7.04	8.26

	Percentage of free acids calculated on the ether and alcohol extracts combined.	Free acids calculated for whole substances.		Total per centage free acids in bacilli.
		Ether extract.	Alcohol extract.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Bovine bacilli	6.48	0.83	0.83	1.66
Swine bacilli	7.02	.46	.92	1.38
Horse bacilli	5.76	1.09	.75	1.84
Avian bacilli	6.55	1.13	.87	2.00
Human bacilli (attenuated)	6.60	1.84	.53	2.37
Human bacilli (virulent)	7.35	1.42	.59	2.01

NOTE.—The free acids were calculated from the acid value and were considered as oleic acid.

Following our earlier work, we have had ash determinations of the various bacilli made, and in addition a determination of the phosphoric acid present in the ash. (These analyses were kindly made by Mr. James A. Emery, of this laboratory.) As the bacilli used for these determinations had all been grown upon the same sort of medium, washed in the same way with approximately the same amount of water, it is fair to presume that the percentage of ash represents approximately, if not absolutely, the ash which would result from a destruction of the organic matter of these bacteria. Sulphuric acid and chlorides were not found, and the high percentage of phosphoric acid seems to be a common characteristic of tubercle bacilli.

TABLE III.—*Ash and phosphorus in tubercle bacilli.*

	Moisture.		Ash.		P_2O_5 in dry bacilli.		P_2O_5 in ash.	
	1.	2.	1.	2.	1.	2.	1.	2.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Bovine bacilli	2.42	2.48	2.66	2.67	1.56	1.55	58.54	58.04
Swine bacilli	2.26	2.06	2.37	2.31	1.30	1.31	55.	56.48
Horse bacilli	2.27	2.42	3.63	3.55	2.07	2.02	55.68	55.40
Avian bacilli	2.40	......	3.96	3.94	2.22	2.19	55.98	55.63
Human bacilli (attenuated)	2.67	2.58	2.44	2.31	1.79	1.71	73.49	74.38
Human bacilli (virulent)	3.91	3.70	3.94	3.92	2.50	2.38	63.47	60.90

In our earlier article upon the mineral constituents of the tubercle bacilli, published in 1898, the percentage of phosphoric pentoxid was found to be a little over 55 in the human germ. As will be noted from Table III, the percentage of phosphoric pentoxid in these human germs was found to be over 60 per cent in the virulent and over 70 per cent in the attenuated. In comparing these figures with the earlier results it should be remembered that the germs used for obtaining the earlier data were grown upon the ordinary glycerine bouillon to which no phosphates had been added, while all of the examinations here recorded dealt with bacilli which were grown upon a medium rich in phosphates. The amount of material available for the phosphoric pentoxid determinations was very small, so that there may be some error due to manipulation, but, allowing for these facts, it is very evident that all of these tubercle bacilli are voracious consumers of phosphoric oxide, in which property they correspond to a great many other plants.

Until we have completed the determination of the exact character of the ether, alcohol, and chloroform extracts obtained from these various bacilli, which are in progress at present, much speculation in regard to the relation of the composition of any one of these organisms to its character and virulence is not warranted. It is interesting to note that the percentage of alcohol extract obtained from the avian bacilli is very much greater than that obtained from any of the other

organisms which were examined, while the percentage of chloroform extract in the bovine bacilli and virulent human bacilli is almost exactly the same, there being but little chloroform extract obtained from the horse, swine, and avian bacilli, while a considerably larger amount is secured from the attenuated human bacillus. The variation in the amount of ether extract is also noticeable, the attenuated human organism showing the largest percentage.

The results which we have obtained certainly indicate that there may be a wide variation in the chemical composition as well as in the morphology and pathogenic power of tubercle bacilli. The results which we have presented here are not sufficient, however, to enable us to draw any definite conclusions in regard to the constant chemical differences, if any really exist, between the several varieties of tubercle bacilli. It will be seen that there may be as great a difference between an attenuated and a virulent human tubercle bacillus as there is between an attenuated human bacillus and a bovine organism, and there seems to be no reason for supposing that there may not be bovine bacilli which will correspond entirely with certain human bacilli in so far as their chemical constitution is concerned. In fact, these results considered alone show only that there may be a wide variation in the chemical composition of tubercle bacilli. They do not indicate that there is necessarily any specific relation between their chemical composition and their virulence. The horse tubercle bacilli, although distinctly more virulent than the most virulent human bacilli which we have analyzed, contain a higher percentage of ether soluble material, and are chemically more closely related to the very attenuated human bacillus than the virulent human bacillus above mentioned. Before drawing any conclusions whatever, therefore, we must wait for analyses of other cultures of tubercle bacilli from various sources, after which it may be that some definite conclusions in regard to the relation between the virulence and the chemical composition may be formed.

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THE DESIRABILITY OF PHOSPHATES AS AN ADDITION TO CULTURE MEDIA FOR TUBERCLE BACILLI.

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During the course of a general chemical examination of tubercle bacilli of human origin, the writer, in collaboration with Dr. E. A. de Schweinitz, made an analysis of the ash of those organisms.[a] The medium upon which the bacilli were grown consisted of ordinary peptonized bouillon containing one-half of 1 per cent sodium chloride and 7 per cent glycerine, the bouillon being neutral at the time of inoculation. The culture flasks were kept in the thermostat at 37.5° C. for several weeks, or until a heavy growth had been obtained, when they were sterilized at 110° C. and the bacilli separated by filtration. After being washed thoroughly with distilled water, the bacilli were transferred to watch glasses and dried over sulphuric acid. The dried organisms were then finely powdered and thoroughly extracted with absolute ether and alcohol. They were then ignited at a low red heat until practically free of carbon, the heat being kept low enough at all times to avoid fusing the residue. The analysis of the ash obtained in this way gave the following results:

	Per cent.
Na_2O	13.62
K_2O	6.35
CaO	12.64
MgO	11.55
C and Si	0.57
P_2O_5	55.23

The most notable fact in this analysis was the absence of sulphates and chlorides and the presence of such large quantities of P_2O_5. If our present ideas regarding the constitution of proteids are correct, sulphur must have been present in at least small quantities in the bodies of the bacteria, and its absence in the ash can be explained by the supposition that it existed in organic combination only and was lost during the combustion. The large percentage of phosphoric acid indicated the desirability, if not the necessity, of the addition of some salt of phosphorus to culture media for tubercle bacilli. It was decided, therefore, to prepare a broth in which a phosphate should replace the

[a] Journ. Amer. Chem. Soc., Easton, V. XX, No. 8, p. 618. Aug., 1898.

chlorides and to compare such a broth with the ordinary sodium chloride bouillon which had been in use in this laboratory for a number of years and which is probably even now employed in most laboratories as a mineral addition to media for the cultivation of tubercle bacilli. The phosphate bouillon was prepared in a number of different ways. In some instances sodium ammonium phosphate was used, in others basic sodium phosphate, and in others acid potassium phosphate. These various lots of bouillon containing phosphate were compared with broth to which sodium chloride had been added in the usual proportions, all other conditions, such as the source of the beef extract, the percentage of glycerine, and the reaction of the media, being identical in the several lots of bouillon. It was found after the first inoculation of these cultures that those lots of bouillon which contained a salt of phosphorus grew more rapidly than the flasks containing sodium chloride, and this notwithstanding the fact that the bacilli with which the flasks were inoculated had been grown for years upon bouillon in which sodium chloride was always present.

Lots of agar tubes were prepared; some containing acid potassium phosphate; others containing sodium chloride. The results of the cultures on solid media were identical with those obtained with the bouillon, the tubes containing phosphate giving a much more rapid and abundant growth than those containing chloride. The accompanying plates illustrate very well the results of these experiments. Plate II shows agar cultures of the same age made on sodium chloride and on acid potassium phosphate agar. All four of the tubes were inoculated with an equal amount of the same culture. This culture had been grown for a number of generations on a bouillon containing acid potassium phosphate but no sodium chloride. Plate III represents four tubes of the same lot of agar, all inoculated at the same time with the same amount of a culture which had been grown for more than eight years on a medium containing sodium chloride and to which no phosphate had been added.

It will be seen that although the culture which is shown in Plate III had been accustomed for many years to the sodium chloride broth, it grew much more vigorously in the first generation upon agar containing acid potassium phosphate. As a result of the above-described experiments, which were confirmed by subsequent work, we have discontinued entirely the addition of sodium chloride to bouillon and agar intended for the cultivation of tubercle bacilli, and have substituted for it an equal amount of potassium hydrogen phosphate. Bouillon of this character, which has been in use in the Biochemic Division for several years, and which has given uniformly satisfactory results, is prepared as follows: To 1 part of freshly chopped meat 2 parts of distilled water are added and the mixture is kept at a temperature of 45° to 58° C. for three hours. The broth is now strained,

boiled, and filtered; 1 per cent of Witte's peptone and one-half of 1 per cent of acid potassium phosphate are added. After these ingredients have been completely dissolved, sodium hydrate is added until the reaction is approximately 1 per cent acid, phenolphthalein being used as an indicator. The solution is now boiled for one hour and filtered. Seven per cent glycerine is added and the reaction, if affected by boiling, is again brought to the previous degree of acidity—that is, 1 per cent acid to phenolphthalein. The completed bouillon is now put in flasks and sterilized in the usual manner. Agar may be prepared from the above-described broth.

A few attempts have been made to cultivate tubercle bacilli directly from the tissues of guinea pigs upon agar containing acid potassium phosphate, but so far without marked success, the agar prepared in this way being apparently much less satisfactory for obtaining the first growth of tubercle bacilli from animals than hardened egg or dog's serum.

In 1894 Proskauer and Beck,[a] starting with Kühne's synthetic medium as a basis, tried various combinations of the inorganic salts, their object being to eliminate those which were of no use and to determine also what elements were absolutely essential for the growth of tubercle bacilli. The simplest medium upon which they were able to obtain a growth of the tubercle bacillus contained commercial ammonium carbonate, primary potassium phosphate, magnesium sulphate, and glycerine, dissolved in water. This medium was not the most favorable one for the growth of the tubercle bacillus, however, but the elements mentioned were found to be essential to its development. It will be seen that they did not find it necessary to add a chloride to the solution.

Inasmuch as all of the text-books on bacteriology recommend the use of the sodium chloride bouillon, glycerinized, for the cultivation of tubercle bacilli, it has seemed desirable to call the attention of workers in bacteriological lines to the medium which has been used in the Biochemic Laboratory for six years and which has proven itself in our hands far superior to that recommended by the text-books. We have been unable to note any change in the virulence of our cultures as a result of their growth upon the phospate bouillon, and tuberculin prepared from such cultures has proven to be perfectly satisfactory.

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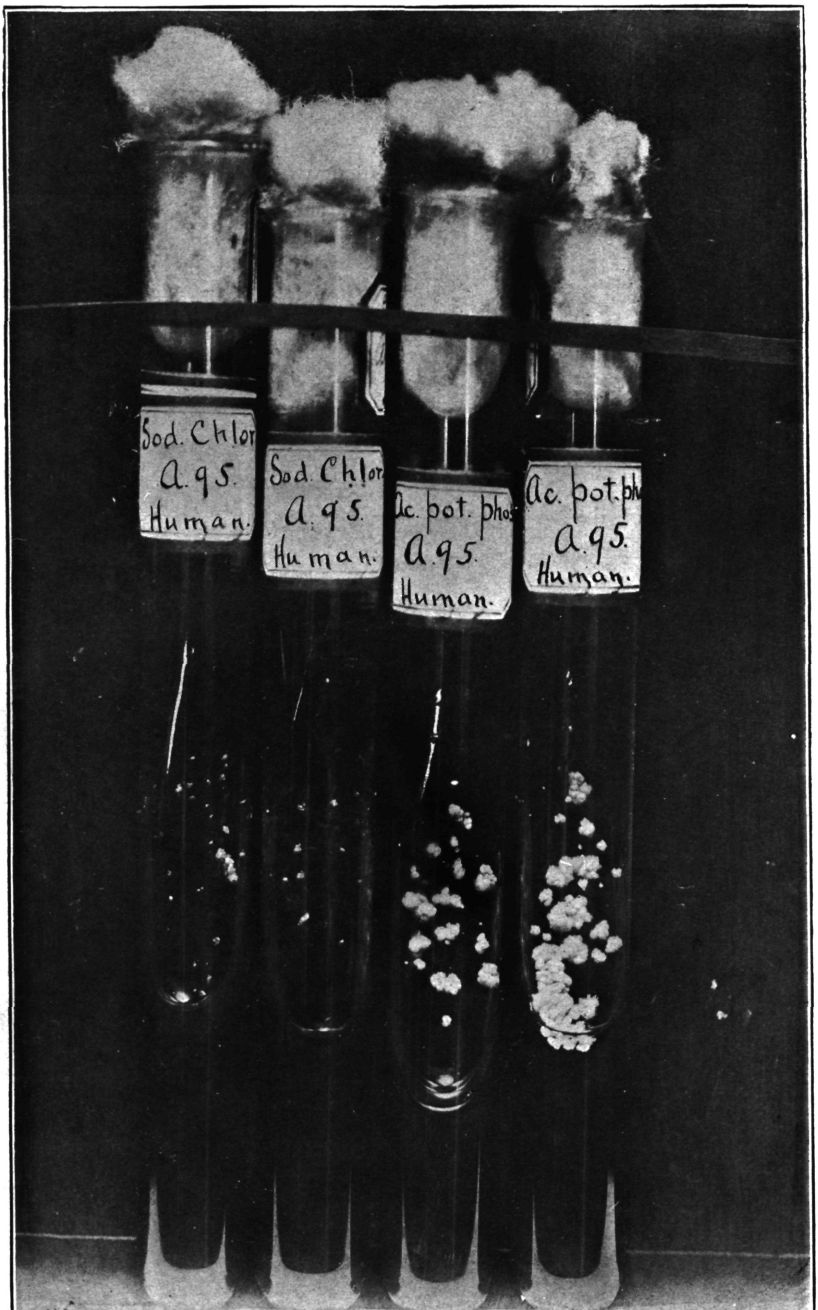
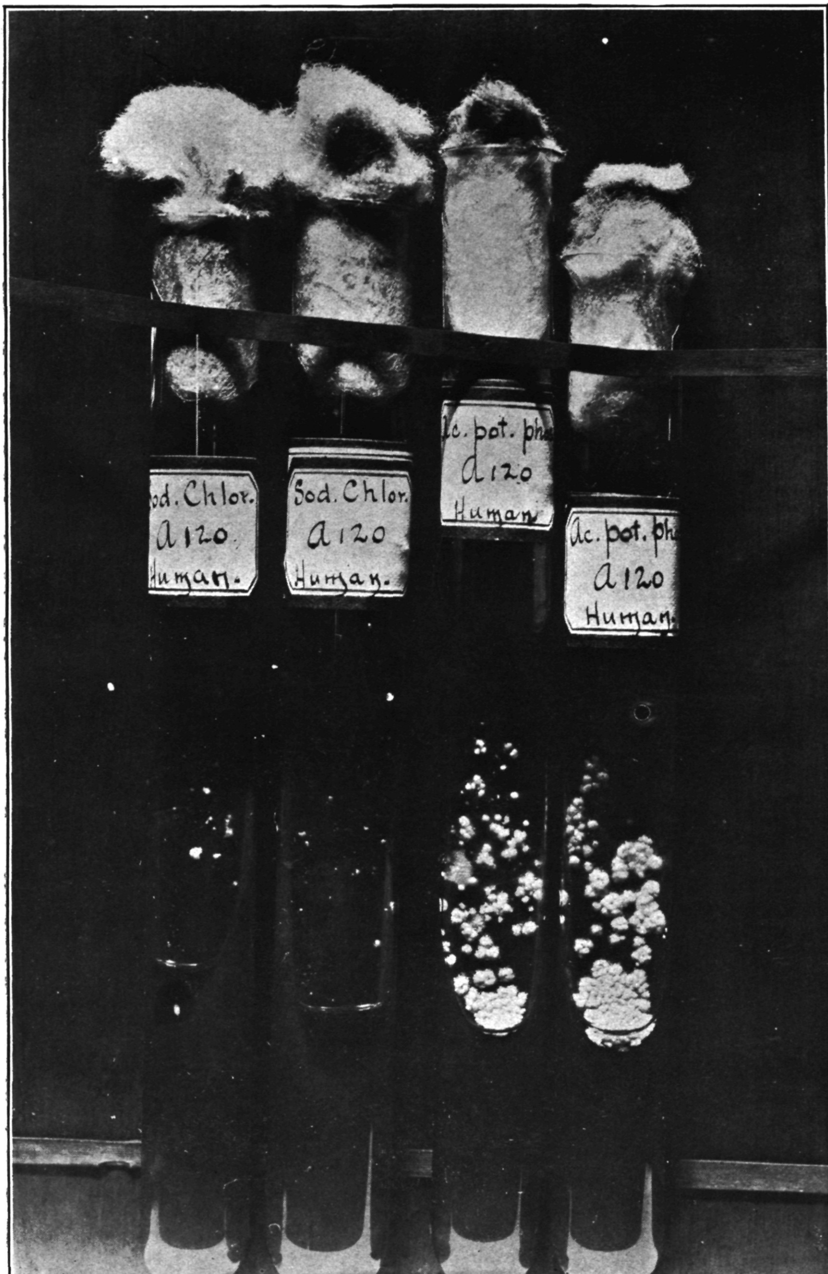
[a] Zeitschr. f. Hyg. u. Infektionskr., Leipz., 18 Bd., p. 128. 1894.



TUBERCULOSIS CULTURES ON SODIUM CHLORIDE AND PHOSPHATE AGAR AFTER HAVING GROWN FOR MANY GENERATIONS ON SODIUM CHLORIDE BOUILLON.



TUBERCULOSIS CULTURES ON SODIUM CHLORIDE AND PHOSPHATE AGAR AFTER HAVING GROWN FOR SEVERAL GENERATIONS ON POTASSIUM PHOSPHATE BOUILLON.

CERTAIN VARIATIONS IN THE MORPHOLOGY OF TUBERCLE BACILLI OF BOVINE ORIGIN.

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The wide variation in morphology of the tubercle bacillus is strikingly shown in the recent work of Wolbach and Ernst,[1 a] which consists in a careful study of the variations in form of the human and bovine bacillus at different ages and on different media. Perhaps the most striking variation noted by these authors occurred in the case of the cultures grown on brain medium, from which long, thread-like, and branched forms were obtained, the human bacilli ranging from 7 to 14 μ and the bovine from 6 to 8 μ in length. These long, thread-like forms are described as staining irregularly and as being made up of alternate faint and deeply stained areas, and some excellent photomicrographs are shown in which the curiously segmented appearance of the threads is well brought out. As the foregoing is the first instance in which long, thread-like forms have been reported for the bovine bacillus, the following observations may be of interest.

In examining some old cultures of *Bacillus tuberculosis*, grown on Dorset's egg medium,[2] it was noticed in several instances that the paraffin used in sealing the tubes had run down and across the surface of the egg, and in each case there appeared along the edges of the streak of paraffin an increased growth or a piling up of the tubercle bacillus, which seemed to be actually encroaching on or growing over the surface of the paraffin. There were three tubes in which this had occurred, namely, cultures of bovine, swine, and dog tuberculosis, which had been cultivated for a number of generations on bouillon before being transferred to egg. The age of these cultures was twenty-one weeks, but the length of time the paraffin had been in contact with the growth was not known, as the cultures had been set aside and neglected for some time. To the naked eye the growths bordering the paraffin were white in color and they separated readily from the paraffin in large masses. Cover-slip preparations from these growths, stained with carbol-fuchsin and decolorized with 25 per cent H_2SO_4, revealed in each case long thread-like, beaded forms, measuring from 6 to 8 μ in length, the bovine and swine reaching 8 μ in length (Pl. IV, figs. 1 and 2). It will be noticed that the threads show alternate stained

[a] These numbers refer to the bibliography at the end of the article.

and faintly stained areas, presenting a beaded appearance very similar to the forms described by Wolbach and Ernst for the brain medium.

Culture tubes of egg, prepared by flowing sterile paraffin (melting point 43° C.) over the surface so as to form a streak, as in the tubes noted above, were inoculated with some of the normal growth—that is, growth away from the paraffin—from the original bovine and swine cultures from which the long, thread-like forms were first obtained, and another from a freshly isolated bovine culture marked Heifer No. 213, the surface of the egg near the paraffin streak being inoculated in each case. These cultures showed the same piling up of the growth along the margin of the paraffin as in the original tubes, and at twenty weeks the growth in all these tubes had coalesced at the center, completely bridging over the streak of paraffin, which averaged about 5 mm. in width. Inoculations on plain egg without the addition of paraffin were made at the same time for the sake of comparison, and preparations from these and the foregoing cultures were measured with the following results, the cover-slip preparations being made always from the inner edge of the growth covering the paraffin in the case of those tubes to which the paraffin was added:

Tubercle bacilli grown on egg in contact with paraffin and on plain egg.

Number of culture.	Egg and paraffin.			Plain egg.		
	2 weeks.	6 weeks.	17 weeks.	2 weeks.	6 weeks.	17 weeks.
	Microns.	*Microns.*	*Microns.*	*Microns.*	*Microns.*	*Microns.*
Swine I, 36	2.5	3	8	2	2.5	3
Bovine III, 37	2	2	3	2	2	2
Heifer No. 213	2	2	3.5	2	2	2

The measurements were made with an ocular micrometer and represent an average of the longest forms in each preparation measured.

It will be noticed in this case that of the cultures to which paraffin had been added, Swine I was the only one that showed marked lengthening, though both of the other cultures showed a tendency to lengthen out, whereas no such tendency was apparent in the case of the cultures grown on plain egg. The growths in contact with the paraffin all showed beading at seventeen weeks.

A culture tube of egg, prepared by flowing sterile paraffin across the surface, was also inoculated from the inner or encroaching edge of the growth bordering the paraffin in the original bovine culture[a] from which the long, filamentous forms were first obtained. This culture, labeled B_1, showed the same piling up of the growth along the edge of

[a] This culture had been cultivated for thirty-seven generations on bouillon prior to its transfer to egg, and the individual organisms at the time of its transference from the bouillon averaged 2.5μ in length.

the paraffin streak, and from it, when eighteen weeks old, a second tube, prepared in the same way, was inoculated in the same manner—that is, from the inner edge of the growth bordering the paraffin, and labeled B_2. Measurements of these cultures gave the following results:

Bovine bacillus grown on egg in contact with paraffin.

Culture.	2 weeks.	6 weeks.	17 weeks.	Check at 17 weeks.
	Microns.	*Microns.*	*Microns.*	*Microns.*
B_1	2	2.5	8	2
B_2	2	3	5	2

From these last measurements it will be seen that growth in contact with the paraffin does not tend to impart any fixed characteristic to the bovine bacillus; that is, the long forms are not perpetuated from one generation to the next.

Inoculations on plain egg without the addition of paraffin were also made from the inner or encroaching edge of the growth bordering the paraffin in the original tubes, from which the long, thread-like forms were first obtained, but in each instance they grew out in the usual short forms characteristic of the egg medium, without any apparent tendency to lengthen. Drawings made with the camera lucida from the bovine culture B_1, grown on egg in contact with paraffin and on plain egg, are shown in Plate V. It is interesting to note that no branching was observed in the filamentous forms obtained from the growths bordering the paraffin.

Cultures of *Bacillus tuberculosis* obtained from different sources, both human and bovine, inoculated on egg across the surface of which sterile paraffin has been flowed to form a streak, show in every case an increase or piling up of the growth along the edges of the paraffin. The organism appears, in fact, to possess a decided affinity for the paraffin, manifesting itself earlier and progressing more rapidly where it comes in contact with the paraffin. In old cultures the growth often completely covers the paraffin, and in some instances where the paraffin is piled up at the bottom of the tubes in large, rounded masses the growth has completely enveloped these masses and continues to grow over the surface of the paraffin after the growth on the surrounding medium has ceased.

Culture tubes of blood serum, glycerine agar, and plain neutral agar, treated with paraffin, were also inoculated with human and bovine tubercle bacilli and the same increase or piling up of the growth was noted at the edges of the paraffin streak, although the increase in growth was not so striking as in the cultures grown on egg. Cover-slip preparations from the growths bordering the paraffin show, in

most cases, that the individual organisms tend to lengthen out after a period of six to seventeen weeks; this tendency, however, does not appear to be constant.

The points of more especial interest in the preceding observations are the occurrence of the long, filamentous forms in connection with the bovine bacillus, and the increased growth in contact with the paraffin.

Filamentous and branched forms of the tubercle bacillus have been frequently noted in avian cultures, in old human cultures, and in cultures that have been subjected to abnormal conditions of growth, such as unfavorable temperatures or media; but until the recent work of Wolbach and Ernst[1] no such forms had been reported in the case of the bovine bacillus. The bovine bacillus, in fact, has always been regarded as more stable in its morphology and less liable to changes in form than the other varieties, so called, of the tubercle bacillus. Thus Theobald Smith,[3] in summarizing his observations on the morphological and biological characters of human and bovine bacilli, states that "bovine bacilli are much less influenced by certain modifications of the culture medium" and "tend to remain short; human bacilli are either more slender from the start or become so during cultivation." A comparison, however, of the extremely short forms characteristic of Dorset's egg medium with the long, thread-like forms noted for the egg in contact with paraffin, and for the brain medium, would seem to show that modifications of the culture medium have a marked effect on the bovine as well as on the human bacillus, and that the bovine bacillus, like the human bacillus, is subject to wide variation in morphology, and that constancy of form under cultivation can hardly be regarded as a distinctive characteristic of the bovine bacillus.

Another point of interest in connection with the growths noted in contact with the paraffin is the occurrence of forms representing the two extremes in morphology on the same medium and in the same culture, the long filamentous forms where the growth borders on the paraffin, and the short micrococcus-like forms from the surface of the egg.

Inasmuch as paraffin is a very stable and indifferent chemical substance, an explanation of the increased growth in contact with this substance would seem to rest on a purely physical basis. An explanation that suggests itself is that the paraffin, cooling suddenly in contact with the egg, incloses a considerable quantity of air in its interstices and thus supplies the growing organism with oxygen. This would account for the continued growth at the margins and over the surface of the paraffin after the growth has ceased on the surface of the egg; it would also account for the continued growth over the paraffin even after the cotton plugs (sealed with paraffin) have been drawn down, in consequence of the exhaustion of the oxygen of the air contained within the tube and the resulting partial vacuum. Furthermore, it might explain

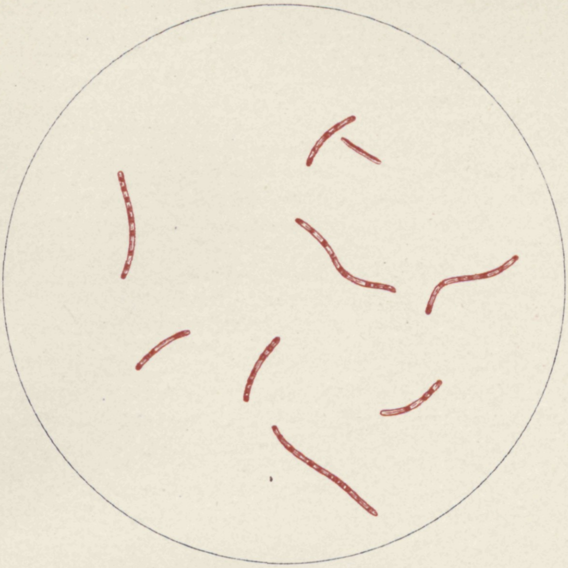

Fig. 1.—Bovine tuberculosis, twenty-one weeks on egg medium plus paraffin. x1400.

Fig. 2.—Swine tuberculosis, twenty-one weeks on egg medium plus paraffin. x1400.

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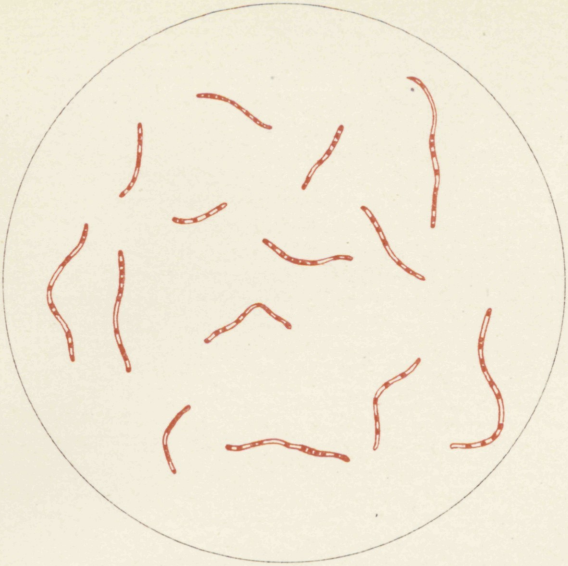

FIG. 1.—BOVINE TUBERCULOSIS, SEVENTEEN WEEKS ON EGG MEDIUM PLUS PARAFFIN. X 1400.

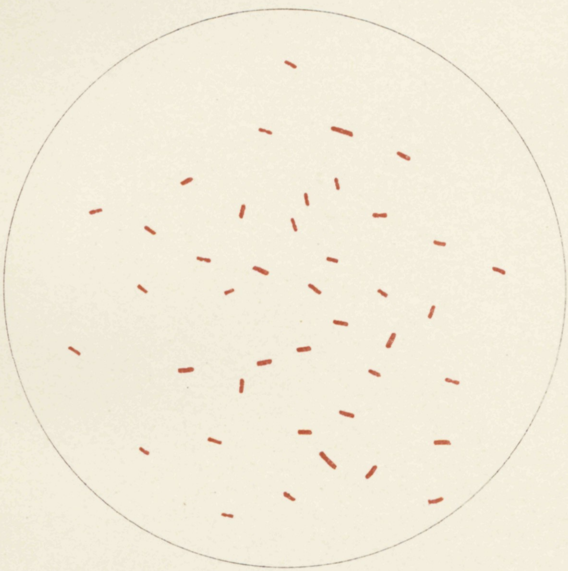

FIG. 2.—BOVINE TUBERCULOSIS, SEVENTEEN WEEKS ON PLAIN EGG MEDIUM. X 1400.

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the occurrence of the filamentous forms in contact with the paraffin; for, according to Coppen-Jones,[4] the conditions best suited for the production of filamentous and branched forms are a favorable medium and an abundance of oxygen. No doubt the paraffin also protects the surface of the egg from evaporation and consequent drying and thus preserves the moisture so essential to the growth of the tubercle bacillus. It must be confessed, however, that this explanation does not appear wholly satisfactory, but none other has suggested itself.

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INFLUENCE OF FORMALDEHYDE ON THE DIGESTIVE ENZYMES.

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This study of the influence of formaldehyde on the digestive enzymes was undertaken with a view of determining for formaldehyde the strength of solutions necessary to cause interference in the action of rennet, pepsin, pancreatin, steapsin, ptyalin, amylopsin, and galactase, in vitro, and what strength would at the same time prevent bacterial development.

The work was done with milk, because milk is, of all foods, the one which most readily undergoes decomposition, and consequently is extensively treated with preservatives, and also because milk is a food on which the activity of most of the digestive enzymes may be determined.

Fresh extracts of the various glands from healthy animals were used to furnish the enzymes which could thus be obtained.

Experiment 1.—Action of formaldehyde on calf's rennet.

The rennet was obtained from the mucous membrane of a calf's stomach by digesting it for twenty-four hours at room temperature in 200 c. c. of a 0.2 per cent hydrochloric-acid solution, filtered, and carefully neutralized. One cubic centimeter of neutralized liquid was used to coagulate 10 c. c. of milk. Formaline[a] was added to 100 c. c. of fresh milk in flasks in the following proportions:

Table I.—*Showing strength of formaldehyde solution added.*

Flask No.—	Formaline.	Formaldehyde equivalent.	Flask No.—	Formaline.	Formaldehyde equivalent.
	Ratio.	*Ratio.*		*Ratio.*	*Ratio.*
1.....	Control.	....	7.....	1:750	1:1,875
2.....	1:20	1:50	8.....	1:1,000	1:2,500
3.....	1:50	1:125	9.....	1:1,500	1:3,750
4.....	1:100	1:250	10....	1:2,000	1:5,000
5.....	1:200	1:500	11....	1:3,000	1:7,500
6.....	1:500	1:1,250	12....	1:5,000	1:12,500

The flasks containing the milk and formaldehyde were corked and set aside at room temperature. Fresh milk was always used in the control. At various intervals 10 c. c. of milk was taken out of each

[a] Formaline is a 40 per cent solution of formaldehyde gas in water.

flask and placed in test tubes, 1 c. c. of rennet solution added, and the tubes placed in the incubator at 40° C.

TABLE II.—*Showing the results of Experiment 1.*

From flask No.—	Proportions of formaldehyde.	Mixtures of milk and formaldehyde tested.		
		After 10 minutes.	After 24 hours.	After 48 hours.
1	Control.	Solid in 7 minutes	Solid in 7 minutes	Solid in 7 minutes.
2	1:50	Not coagulated in 18 hours.	Not coagulated in 18 hours.	Not coagulated in 18 hours.
3	1:125	do	do	Do.
4	1:250	do	do	Do.
5	1:500	do	do	Do.
6	1:1,250	Solid in 10 minutes	Solid in 10 minutes	Solid in 10 minutes.
7	1:1,875	do	do	Do.
8	1:2,500	Solid in 7 minutes	Solid in 7 minutes	Solid in 7 minutes.
9	1:3,750	do	do	Do.
10	1:5,000	do	do	Do.
11	1:7,500	do	do	Do.
12	1:12,500	do	do	Do.

These results show that formaldehyde added to milk in the proportion of 1:2,500 does not interfere with the rennet's coagulation, while the proportion of 1:1,875 retards the coagulation, and the proportion of 1:500 renders the milk incapable of being coagulated in eighteen hours.

Experiment 2.—Action of formaldehyde on pepsin.

The pepsin used was in the form of artificial gastric juice prepared from the stomach of a pig. The stomach was opened, emptied of the contents, and then the surface cleaned with a wet sponge. The mucous membrane was removed from all but the pyloric end of the organ; it was then freed from a portion of the water which was adhering to it by pressure between dry cloths and minced. The finely divided mucous membrane was then placed in 2 liters of dilute hydrochloric acid, containing 6 c. c. of concentrated hydrochloric acid per liter, and the mixture digested in the incubator at 40° C. for a day. The liquid was then filtered through paper, and 50 c. c. added to 200 c. c. of a 0.1 per cent hydrochloric acid solution; 10 c. c. of this solution was added to 1 c. c. of milk treated as in Table I and set aside in incubator at 40° C.

It has been demonstrated by Hammarsten and other workers[1-2] that milk, when subjected to the action of pepsin hydrochloric acid, is broken up into calcium paracasein and a small amount of albumose-like albumin. The paracasein is precipitated, and may be recognized after digesting the milk for a short time, the paracasein separating and finally decomposing with the formation of paranuclein. Any foreign matter that interferes with the formation of paranuclein interferes with the digestion of the milk. This feature was taken to determine when the formaldehyde affected the digestibility of the milk. It was found that upon the addition of formaldehyde in the proportion

of 1:50 the pepsin digestion was retarded, while in a stronger solution, or in the proportion of 1:25, the digestion was materially interfered with; and in the proportion of 1:125 or less, the digestion was normal with the control.

Experiment 3.—Action of formaldehyde on pancreatin.

Two hundred grams of finely chopped fresh pancreas, free from fat was digested in a liter of water for twenty-four hours, filtered, and the solution made up to twice its volume with a 2 per cent solution of sodium carbonate; 10 c. c. of this mixture was added to 1 c. c. of milk, as in Experiment 2, placed in the incubator at 40° C. and tested every two hours until the control gave no precipitate when saturated with magnesium sulphate, thus showing that all the proteids were in the form of pepton. At the end of eighteen hours the control showed the absence of all proteids that were precipitated by magnesium sulphates, and the tubes containing formaldehyde in the proportion of 1:2,000 or less showed the same, while in the tubes containing formaldehyde in the proportion of 1:1,500 or more the digestion was interfered with.

Experiment 4.—Action of formaldehyde on steapsin.

One hundred grams of finely chopped pancreas free from fat was mixed with 1 liter of a solution of glycerine containing 900 c. c. of glycerine and 100 c. c. of a 1 per cent sodium carbonate solution. This mixture was allowed to stand at room temperature for three days, filtered through linen, and the filtrate used for its fat-splitting enzyme; 2 c. c. of this extract was added to 1 gram of neutral fat obtained from cream by shaking with alkaline ether and then washing well with water. To this neutral fat solution were added varying proportions of formaldehyde. To the tubes containing 1 gram of the fat and 2 c. c. of the extract 10 c. c. of water was added, the tubes shaken in a milk shaker, set aside at 40° C., and then shaken every half hour for twelve hours at this temperature. Their acidity was then determined, using phenolphthalein as indicator. It was found that formaldehyde in the proportion of 1:35 prevented the action of steapsin, and in the proportion of 1:50 the action of steapsin was retarded, while weaker solutions had no effect on the activity of the enzyme.

The enzymes used in the preceding experiments practically are the ones whose activity, if interfered with, would affect the digestibility of milk, but formaldehyde is often used as a preservative for food containing a large amount of starch. The enzymes, ptyalin and amylopsin, were studied with regard to their activity with starch when the starch was in the presence of formaldehyde solutions of varying strengths.

Experiment 5.—Action of formaldehyde on ptyalin.

The filtered saliva was used for the ptyalin enzyme. One gram of potato starch, which had been thoroughly washed with dilute hydro-

chloric acid and caustic potash and then washed well with water, was thoroughly mixed in a mortar with cold water, and the thick liquid then poured with constant stirring into boiling water, and the boiling continued about three minutes; 10 c. c. of this mixture was treated with solutions of formaldehyde of varying strength, as shown in the table below, and 2 c. c. of saliva added, the mixture placed in the incubator at 40° C., and tested with iodine solution every two minutes, with the following results:

TABLE III.—*Showing the results of Experiment 5.*

Flask No.—	Proportion of formaldehyde.	Results.
1	Control.	Colorless with iodine after 10 minutes.
2	1:100	Blue with iodine after 10 minutes.
3	1:200	Do.
4	1:500	Do.
5	1:750	Nearly colorless with iodine after 10 minutes.
6	1:1,000	Do.
7	1:1,250	Do.
8	1:1,500	Colorless with iodine after 10 minutes.
9	1:2,000	Do.
10	1:5,000	Do.
11	1:10,000	Do.

The result of these experiments show that the ptyalin's action on starch is interfered with only after formaldehyde has been added to the starch in the proportion of 1:1,250, while in 1:1,500 or less, the ptyalin's activity is normal.

Experiment 6.—Action of formaldehyde on amylopsin.

One hundred grams of finely chopped pancreas free from fat were digested five days, with an occasional shaking, with 400 grams of 25 per cent alcohol, filtered, and 10 c. c. added to 100 c. c. of starch paste prepared as in Experiment 5, with the following results:

TABLE IV.—*Showing the results of Experiment 6.*

Flask No.—	Proportion of formaldehyde.	Results.
1.....	Control.	Colorless with iodine after 25 minutes.
2.....	1:200	Blue with iodine after 25 minutes.
3.....	1:500	Do.
4.....	1:750	Nearly colorless with iodine after 25 minutes.
5.....	1:1,000	Colorless with iodine after 25 minutes.
6.....	1:1,250	Do.
7.....	1:1,500	Do.
8.....	1:2,000	Do.
9.....	1:5,000	Do.

These results show that when formaldehyde was added to starch in the proportion of 1:500 it interfered with the action of the amylopsin, while in the proportion of 1:1,000 or less it had no marked effect.

Summarizing the results of these experiments *in vitro*, we find that formaldehyde may be added to foodstuffs in the proportion of 1:2,500 without affecting the activity of any of the enzymes used. However, there is present in milk an active proteolytic enzyme, galactase, discovered by Babcock and Russell[3] and found by them to play an important part in the ripening of cheese. The part this enzyme plays in the digestion of the milk when taken into the system has not as yet been entirely proven. Snyder[4] studied the effect of the enzymes in milk, and claims that when milk was used in a mixed diet the protein was from 4 to 5 per cent more digestible than when the milk was omitted. Snyder[4] also claims that, upon digesting toast for two hours with 10 c. c. of milk, 12.20 per cent of the protein of the toast was digested. These results suggested that the soluble or chemical ferments of milk were the active agents which caused this increase in digestibility. Very little work has been done to show the effect of formaldehyde on the activity of the enzyme galactase. Babcock and Russell[5] claim that formaldehyde prevents the action of galactase, although they quote no experiments to prove their assertion. Van Slyke[6] concluded, from experiments conducted at the New York Experiment Station, that formaldehyde in 0.1 per cent solution inhibits the action of this enzyme. No weaker solution of the formaldehyde was tried.

In studying the effect of formaldehyde on the enzyme galactase, the concentrated extract of the enzyme was used. This was obtained by allowing the slime that was taken from the milk-separator cylinder to macerate for forty-eight hours in a closed vessel containing water, to which chloroform had been added in excess. This emulsion was filtered, and 25 c. c. of the filtrate added to each of the seven sterile flasks. Formaldehyde was then added to Flasks Nos. 1, 2, 3, and 4 in the proportion of 1:1,500, 1:2,500, 1:5,000, and 1:10,000, respectively, while Flasks Nos. 5, 6, and 7 were not treated. The flasks were set aside at room temperature, and at the end of forty-eight hours to Flasks Nos. 1, 2, 3, 4, and 5 was added 100 c. c. of milk collected under antiseptic conditions and containing 20 per cent chloroform. To Flasks 6 and 7 was added 100 c. c. of milk collected under the same conditions but containing formaldehyde in the proportions of 1:1,000 and 1:2,000, respectively. Flask No. 5 served as a control, Babcock[5] having shown that chloroform, when added to milk even as high as 30 per cent, had no effect on the activity of the enzyme galactase. Plates were made, using 1 c. c. of the content of each flask, and showed the absence of bacteria. The total nitrogen and soluble nitrogen were then determined in 10 c. c. of the mixtures, the flasks set aside at 40° C. for two weeks, and at the end of this time plates were again made, and showed that the mixtures were still free from bacteria. The total nitrogen and soluble nitrogen were also

determined, as before. The results are summarized in the following table:

TABLE V.—*Showing the effect of formaldehyde on galactase.*

Flask No.—	Extract and formaldehyde.	Milk and—		Total nitrogen at beginning of experiment.	Soluble nitrogen at beginning of experiment.	Total nitrogen at end of experiment.	Soluble nitrogen at end of experiment.
		Chloroform.	Formaldehyde.				
	Ratio.	*Per cent.*	*Ratio.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1.....	1:1,500	20	....	0.56	0.11	0.57	0.15
2.....	1:2,500	20	....	.51	.10	.51	.13
3.....	1:5,000	20	....	.54	.10	.56	.18
4.....	1:10,000	20	....	.53	.10	.56	.24
5.....	....	20	....	.53	.10	.56	.26
6.....	....	....	1:1,000	.55	.09	.56	.09
7.....	....	....	1:2,000	.57	.10	.58	.10

These results show that formaldehyde retards the action of the enzyme galactase when used in very concentrated solutions, but in weaker solutions it seems to have little effect, and, although the minimum solution necessary for preserving purposes was not tried, the results from the solutions that were used go to show that the formaldehyde when used in milk in sufficient amount to preserve the milk would have no material effect on the enzyme.

As Snyder[4] claims that 12.2 per cent of the protein in toast was digested in two hours by milk alone, I attempted to determine the amount of protein in toast that was digested in two hours by the extract of the enzyme prepared as in the previous experiment, and also with the milk alone, and then to study the effect of solutions of formaldehyde of varying strengths on the digestive properties of the enzymes, with the following results:

TABLE VI.—*Showing the effect of formaldehyde on the digestive properties of galactase.*

	Per cent.
Soluble nitrogen before digestion:	
10 grams toast, 10 c. c. extract, chloroform and 90 c. c. water..	2.22
Soluble nitrogen after digestion:	
10 grams toast, 10 c. c. extract, chloroform, no formaldehyde.	2.22
10 grams toast, 10 c. c. extract, chloroform, 1:2,500 formaldehyde	2.28
10 grams toast, 10 c. c. extract, chloroform, 1:5,000 formaldehyde	2.22
10 grams toast, 10 c. c. extract, chloroform, 1:10,000 formaldehyde	2.28
10 grams toast, 10 c. c. extract, chloroform, 1:20,000 formaldehyde	2.28
Soluble nitrogen before digestion:	
10 grams toast, 10 c. c. milk, chloroform and 90 c. c. water	2.34
Soluble nitrogen after digestion:	
10 grams toast, 10 c. c. milk, chloroform, no formaldehyde ...	2.34
10 grams toast, 10 c. c. milk, chloroform, 1:2,500 formaldehyde.	2.36
10 grams toast, 10 c. c. milk, chloroform, 1:5,000 formaldehyde.	2.34
10 grams toast, 10 c. c. milk, chloroform, 1:10,000 formaldehyde.	2.34
10 grams toast, 10 c. c. milk, chloroform, 1:20,000 formaldehyde.	2.34

These results are contrary to those of Snyder.[4] As will be noticed, the amount of soluble nitrogen after two hours' digestion is the same as the amount previous to digestion. This difference in results is probably due to my using an antiseptic, while in Snyder's work, no antiseptic being used, bacteria are responsible for the increase in soluble nitrogen and not the enzyme galactase.[a]

Formaldehyde having been found to be harmless in its effect on the activity of these enzymes when used in solutions of such strength as are necessary for preserving food material and there being often danger of development in foodstuffs of various organisms which may be taken into the system through the food and liberate toxins which produce serious trouble, it was of interest to determine whether the formaldehyde would arrest development or kill the organism when it came in contact with it in the foodstuffs.

Some of the organisms commonly found in milk, such as *Bacillus acidi lactici*, *B. subtilis*, *B. typhosus*, *B. coli communis*, and *Staphylococcus pyogenes aureus*, were inoculated into bouillon tubes containing formaldehyde of different proportionate strengths and set aside in the incubator for twenty-four hours. Formaldehyde in the proportion of 1:20,000 prohibited development under these conditions. This, of course, does not show that formaldehyde killed the organisms. This point was also determined by inoculating another set of tubes with the organisms and allowing them to develop for twenty-four hours. Then formaldehyde solutions of varying strength were added and the tubes set aside in the incubator. At the end of twenty-four, forty-eight, and seventy-two hours, 1 c. c. was taken from each tube and added to flasks containing 50 c. c. of fresh bouillon solutions, these flasks set aside in the incubator, and the results noted. These results showed that it required formaldehyde solutions in the proportion of 1:1,560 to destroy the organisms in twenty-four hours, while the proportion of 1:1,870 destroyed the organisms in seventy-two hours. It was found that the organisms varied in their resisting power, but the strength solutions given include all these organisms.

We find a great number of people who hold that artificial digestion experiments and animal digestion experiments are worthless. It is true that a majority of conductors of artificial digestion experiments used commercial products for their active enzymes instead of fresh extracts of the various glands, and some of these workers have made no attempt to duplicate the mechanical conditions which obtain in the living stomach. The general value of their conclusions is somewhat lessened on this account, but the results, being in most cases comparative, certainly can not be said to be worthless. The results of the

[a] Snyder has recently duplicated his work, using an antiseptic, and quotes results in Bul. No. 86 of the Minnesota Experiment Station concordant with those he obtained when no antiseptic was used.

majority of workers who have experimented with formaldehyde are of no practical value, as we find on reviewing the literature on this subject that most workers[7-13] have used formaldehyde solutions varying in proportion from 1:25 to 1:2,000, which is out of proportion to the amount actually used or required. The chief object of most of the work that has been done was to see if formaldehyde interfered with digestion. In most cases it appears as if the workers took quantities of formaldehyde large enough to insure interference and made no attempt to study the minimum amount that could be used without interference.

CONCLUSIONS.

From the experiments the following may be drawn:

(1) Formaldehyde added to milk in the proportion of 1:20,000 preserved the milk for forty-eight hours.

(2) Formaldehyde added to milk in the proportion of 1:2,500 or less has no effect on the activity of the fresh enzymes, rennet, pepsin, pancreatin, and steapsin *in vitro.*

(3) Formaldehyde added to starch in the proportion of 1:2,500, or less, has no effect on the conversion of the starch by the enzymes, ptyalin, and amylopsin *in vitro.*

(4) Formaldehyde added to milk in sufficient quantity to preserve the milk for forty-eight hours—that is, 1:20,000—does not interfere with the action of the enzyme galactase *in vitro.*

(5) Formaldehyde added to milk in the proportion of 1:20,000 prevents the development of the more common bacteria found in milk, and when added in the proportion of 1:1,560 it kills these bacteria.

(6) Formaldehyde may be added to milk in sufficient quantities to preserve the milk and prevent the development of some of the more common bacteria—that is, 1:10,000—and still have no deleterious effect on the digestibility of the milk *in vitro.*

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PULMONARY MYCOSIS OF BIRDS—WITH REPORT OF A CASE IN A FLAMINGO.

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INTRODUCTION.

The association of fungi with many pathological conditions, both in man and the lower animals, has frequently been observed, and among the more important of these affections may be considered pulmonary mycosis. This, as the name indicates, is a disease of the air passages or pulmonary tissue, due to the entrance and subsequent development there of some species of fungus, or mold.

Comparatively speaking, there are but few fungi pathogenic for man and the lower animals, but that there are some is occasionally evidenced by the discovery on autopsy of pneumonias produced by them. These infections of the respiratory apparatus are termed pulmonary aspergillosis when due to one of the various species of Aspergilleæ, which, in most instances, is the variety known as the *Aspergillus fumigatus*, or smoky aspergillus. Besides the Aspergilleæ, other forms of fungi which may be mentioned as being pathogenic under certain circumstances belong to the Mucor, Oïdium, and Oöspora families. Some of the species variously concerned in the etiology of disease processes are *Aspergillus niger* (van Tieghem, de Barry), *A. glaucus*, *A. candidus* (Robin), *A. fumigatus* (Fresenius), *A. flavus* (de Barry), *A. nidulus* (Eidam), *Eurotium malignum* (Lindt), *Mucor corymbifer* (Lichtheim), *Tricothecium roseum* (Link), and some few others. The parts of the animal body which may be affected are the eye, ear, respiratory apparatus, mouth, liver, kidneys, intestines, lymph glands, genital organs, and the skin.

The pulmonary affection of which this article treats seems to be practically unknown in this country if one is to judge by the number of cases reported, there being only four with which we are familiar, while the other three American reports on aspergillosis refer to the disease affecting the ear and maxillary antrum. But the European literature is fairly rich on the subject, numerous cases having been reported, especially in the past ten years, both in man and animals.

The caseous and pneumonic areas produced often bear a close resemblance to pulmonary actinomycosis, glanders, and tuberculosis. Owing to this similarity, particularly that produced in the experimental disease, to the latter affection, the name pseudo-tuberculosis aspergillina has been suggested by various writers. A large amount of experimental work has been done and the lesions carefully studied, so that the importance of making our case, below mentioned, the subject of a paper may not be apparent; nor is it justified in the light of an economic consideration. However, it is sent forth with the idea that perhaps the disease is more prevalent here than has been reported and that this article may elicit greater interest in the true nature of pathological lesions not bearing the unmistakable imprint of tuberculosis or actinomycosis, which conditions it most closely simulates.

HISTORY.

A slight historical review of mycotic affections may be of interest, although it must be admitted that the majority of these earlier articles are incompletely described and the particular species of aspergillus undetermined, or at least only arbitrarily so. This fungus appears to have a predilection for birds, as by far the greatest number of the reported cases refer to the affection in these animals. The first observation was made in 1815, by Mayer and Emmert, who found a fungus in the lungs of a jay. In the following year Jaeger reported the disease in a male swan. From this time numerous instances of cases of mycotic affections have followed one after the other in quick succession in the various domestic and wild birds and in cattle, sheep, horses, dogs, and man. Thus it was reported by Heusinger (1826) in the cavities of the long bones of a white stork; by Thiele (1827), in the lungs of a raven; by Owen (1833), in the bronchi and pulmonary tissue of a flamingo; by Deslongschamps (1841), in the bronchi and air sacs of an eider duck; Rousseau and Serrurier (1841), in the lesions of tuberculosis of a paroquet, and in a pigeon and chicken; by Mueller and Retzius (1842), in the respiratory apparatus of a hawk; by Rayer and Montagne (1842), in the air passages of a tuberculous bullfinch; by Spring (1848), in the abdominal air sacs of a plover; by Robin (1853), in the tuberculous areas of a pheasant; by Fresenius (1858), in the pulmonary tissue of a bustard; by Bouchard (1866), in the lung of a parrot; by Hayem (1872), in lesions simulating caseous pneumonia in ducks; by Leidy (1875) and by Heusinger (1875), in the lungs of flamingos; by Bollinger (1878), Generali (1879), Kitt (1881), and Renon (1893), in pigeons; by Wolff (1883), in the air sacs of gray parrots; by Perroncito (1884), in a chicken; by Schutz (1884), in geese; by Bizard and Pommay (1887), in an ostrich; by Rivolta (1887), in pheasants; by Zschokke (1887), in a swan; by Lignieres and Petit (1898), in a turkey, and by Bland Sutton (1885), who found moldy air sacs as

an exceedingly common condition in the birds dying at the London Zoological Garden, especially among those living in damp places. Pulmonary mycosis has also been noted by other writers in various other birds, and it has been observed to exist at times as an epizootic among poultry. The first case of mycosis in man was reported in 1842, by Hughes Bennett, in the sputum, vomicæ, and tubercles of a phthisical patient, although it was not until 1847 that Sluyter definitely demonstrated an aspergillus in the lungs of a patient. In 1856 Virchow,[a] who gives references to all previous cases, recorded the presence of aspergillar development in the bronchi and cavities of three tubercular subjects, but he regarded the mycotic invasion as a concomitant occurrence and did not seem to attach much importance to its presence, at least in regard to the genesis of the lesions found. He had also described a condition of the lungs, to which he gave the name of odorless gangrene, which Saxer thinks was due to the invasion of the lung by an aspergillus. In 1879 Leber first described a purulent keratitis due to an aspergillus infection. Popoff, in 1887, noted in a tuberculous patient, who presented the clinical picture of bronchial asthma, an infection not only of the bronchioles but of the lung tissue with *Aspergillus fumigatus.*

The importance of pulmonary mycosis was indicated in 1890 by Dieulafoy, Chantemesse, and Widal,[b] who reported their observations and studies of pneumonomycosis as it occurs in a certain class of men in Paris. These men feed thousands of young pigeons daily by taking into their mouths a mixture of grain and water which they force into the mouths of the birds much in the same way that the old pigeons feed their young. It had been a matter of common observation that these men were sufferers from a severe pulmonary disorder; but when their sputum was examined, instead of finding tubercle bacilli, only threads of mycelia were detected. This observation was subsequently confirmed by Renon and other investigators. Until this time it had been held that the presence of fungi in the lung tissue was of secondary importance, but these observations dispelled further argument. Experiments on animals in which they were made to inhale the spores were successful in producing the disease; thus it was that natural infection was proved. With reference to pigeon feeders, it was not ascertained whether they contracted the disease from the pigeon or from spore-contaminated grain until the observation was made in the case of a pigeon which showed mycelia to be developing from a grain of corn that had passed into the bronchiole of the bird. This fact would indicate the probability of infection of these men from a like source.

From observations in England, made by Boyce in 1892 and Arkel

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[a] Virchow's Archiv., Bd. IX, heft 3, pp. 557–593.

[b] Gazette des Hôpitaux, 63, No. 89, 1890, pp. 821–823.

and Hinds in 1896, the disease in man was shown to be of primary origin, but, on the other hand, there can be no doubt that infection will take place more easily in subjects whose lungs are in an already weakened condition.

In 1897[a] Renon published the results of his researches on aspergillosis as seen in birds and animals, and came to the following conclusions:

1. That aspergillosis is a spontaneous disease affecting the bronchi and lungs of birds and animals, and creating in the animals a generalized affection similar to hemorrhagic septicemia; that it develops in eggs in incubation and may contaminate the embryos contained therein.

2. The disease may be transmitted experimentally. The botanical and cultural characters of the fungus and the lesions it provokes are truly specific. In its pathogenic action it bears a strong resemblance to the tubercle bacillus.

3. In man it develops upon the cornea or skin, but has its particular evolution in the respiratory apparatus, creating pulmonary mycosis, resembling tuberculosis, and pulmonary gangrene, but without the fetid odor. It may coexist with tuberculosis. Occasionally it is fatal after the formation of cavities in the lungs. It may invade the bronchial apparatus alone, causing membranous bronchitis of special form and of long duration.

4. In all its manifestations *Aspergillus fumigatus* may play a primary or secondary rôle in both man and animals. It is not, therefore, a simple saprophyte, but a true parasite.

Renon speaks with considerable authority on account of having studied the disease closely in man, besides doing a vast amount of experimental work on animals. His studies of the disease in man showed it to be frequently produced in those whose occupations are of necessity connected with the handling of grain upon which the aspergillus grows or, in fact, any occupation where men are obliged to inhale dust laden with spores. Animals and birds kept in the working rooms of hair-assorting establishments, where rye flour is used as an application to help disentangle the matted hair, became affected and died with aspergillosis of the lungs.

In 1900 Saxer[b] published a historical monograph giving in detail a description of four cases that he had seen in man. In one he had observed a beginning mycosis in croupous pneumonia; in another a fungous development in a large cavity in the lungs of a phthisical patient and consisting of a typical odorless gangrene; in a third healing was taking place, the lung being irregularly nodular and indurated. There is given a full account of his own experimental work, as well as a review of that of others, especially of French authors, and a most complete bibliography of the subject up to that time.

The first observation of mycosis in a domesticated animal was reported by Rivolta in 1857, who observed the fungus in the pharyngeal abscess of a horse. Other cases have been reported by Gotti (1871), who found an aspergillus in auricular catarrh of a dog; by

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[a] Étude sur l'aspergillose chez les animaux et chez l'homme, Paris, 1897.

[b] Pneumonomycosis aspergillina, Jena, 1900.

Pech (1876), who observed mycotic pneumonia in seven subjects in a stable where the horses had been fed on moldy hay; by Zurn (1876) in the trachea of a cow; by Martin (1883) in pulmonary abscesses of a horse; by Roeckl (1884) and by Piana (1886) in the lungs of a cow; by Franck (1890) in the greenish caseous nodules in the intestines of cows; by Mazzanti (1891) in the lungs of a lamb; by Goddall (1893) in the ear of a horse; and by Siedamgrotzky (1879), who has seen mycotic pneumonia only as a result of traumatism of the lungs by foreign bodies.

In this country aspergillosis has been observed in but few instances. In addition to the two above-mentioned cases in birds, there have been reported by Theobald (1881) four cases of aspergillosis of the human ear and a subsequent case of a similar affection in 1898. Mackenzie (1893) published a report of finding the *Aspergillus fumigatus* in the maxillary antrum of a woman. In 1887 Osler[a] placed on record the case of a woman who for twelve years had had a severe cough, and in the expectorations mycelial filaments of aspergillar variety were demonstrated. In 1900 Pearson and Ravenel[b] published a review of work done by various investigators on aspergillosis, and gave a very interesting and instructive description of a primary pneumonomycosis of the lung of a cow which had resisted all forms of treatment in efforts to check a progressing emaciation, the nature of which was not understood until the death of the animal.

PATHS OF INFECTION.

The liability of the feathered creation to pulmonary aspergillosis is well known, and all species of birds appear to be receptive to the fungus. That the inhalation of spores is by far the most frequent method of infection is admitted by all, and is plainly illustrated by the reported cases. However, Lucet[c] has reported one case of intestinal aspergillosis, Franck has described a similar condition in a cow, Renon noted several cases in rabbits which he produced experimentally by feeding, and Ceni[d] has recently recorded a number of instances in man. Renon and others have also shown that the embryo can become infected through the shell of an egg during incubation. Traumatism has likewise been held accountable for the entrance of the fungus. These latter modes of infection are so infrequent, however, that for all preventive purposes the respiratory tract may be considered as the point of selection of the fungus. The experiments so far conducted have not added materially to our intimate knowledge of the working of the spores of the aspergillus after they are implanted on the bronchial

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[a] Trans. of the Path. Soc. of Phila., Vol. XIII, pp. 108–109.

[b] Jour. of Comp. Med. and Vet. Arch., Vol. XXI, No. 8, Aug., 1900, pp. 451–465.

[c] De l'aspergillus fumigatus chez les animaux domestiques et dans les œufs en incubation, Paris, 1897.

[d] Centralbl. fur a. Path. und Path. Anat. Bd. XIV, No. 12, Juli 1903, s. 465–468.

mucosa. The fact that they often produce pneumonias in birds is well established, but just how or why certain species of the Aspergilleæ should be the organism most often concerned is another question which remains to be solved. Lately a great deal of work has been done by Ceni and Besta in their investigation into the cause of pellagara in an effort to isolate the toxin which they think is responsible in a great measure for the symptoms and lesions shown. In fact they claim to have isolated a very virulent toxin from the spores of *Aspergillus fumigatus* and *A. flavus*, but thus far they have not given sufficient proof of this statement. Dogs and rabbits inoculated intra-abdominally with quite large doses died within a few hours to several days with tetanic symptoms, and showed on postmortem examination a general hyperemia of all the organs. Their work in this line has not been confirmed; but should it prove to be authentic, it will go a long way in explaining the ease with which the spores of the genus Aspergilleæ enter, overcome, and germinate in the tissues. It has been claimed heretofore that the *Aspergillus fumigatus* produced little or no toxin, and that the destructive properties were due to mechanical irritation alone, but the extensive alterations noted in the tissues appear to be entirely too severe to lay to mechanical interference alone. Once having obtained a foothold, the work of tissue destruction is rapid and complete. Infection no doubt in most cases takes place by inhalation of spores, but that many of these never reach very far into the bronchial branches, and that they are thrown out in the bronchial secretions is very likely.

After their implantation on the bronchial mucosa, many of them germinate and come to full maturity. The spores given off from the fruit heads are then disseminated in the bronchioles and cavernous air spaces, where they exist as a further source for new centers of infection. This fructification can be easily demonstrated on postmortem examination by taking scrapings from the mucosa and putting them under the microscope or by making sections of the diseased lung tissue and examining them after staining with suitable aniline stains, when their relation to the mucosa will be demonstrated. Now, whatever energy is expended from the time of germination of the spores until fructification, just that amount of energy is abstracted from the media upon which they are growing, and in the case of a pulmonary infection this energy is drawn from the tissues. Animals and plants do not possess the faculty of assimilating crude nutritive materials direct, but must have them prepared specially. The foods are altered in both cases through the agency of enzymes. It has been shown lately that bacteria and fungi also must have their food so prepared either by intracellular or extracellular enzymes, and it is possible that the intense tissue reaction in cases of pneumonomycosis may be due to some such digestive process. This would be difficult to prove, but it does not

appear at all improbable, and it would account in a measure for the death of the tissues in the pseudotubercular nodules. Numerous experiments have been tried with the various fungi, especially in relation to the best temperatures for their development and fructification, and it has been found that, although a few are able to germinate in the bronchioles, the *Aspergillus fumigatus* is about the only one which develops a vigorous growth there and fructifies, the temperature of the human body seeming to be quite suitable for this species. Most of the other molds develop at a much lower temperature and are therefore usually harmless even if introduced into the lungs. But for the *Aspergillus fumigatus* the lungs act as a veritable propagating house, furnishing a moist, nutrient soil upon which to grow and a congenial warm, moist atmosphere with a sufficient amount of oxygen for its demand to come to complete maturity and for fructification to take place. When the fungous growth is localized in the bronchial mucous membrane, the condition is known as bronchomycosis. It may be that the tissues are able to forestall entrance into their substance and finally the fungi die and recovery takes place. In birds the growth may extend to the air sacs; this condition is then called cytomycosis. Cases of cytomycosis are very rare; and when it does occur, emaciation of the birds is the predominating symptom. When the lung tissue itself is the seat of invasion, the term pneumonomycosis is applied.

Invasion of the lung tissue by the mycelium is the occasion for an intense inflammatory disturbance with positive chemotaxis. However, this tissue reaction seems to offer the most trifling barrier to the parasitic encroachment in such weakly subjects as birds. Generali states that delicate breeds of pigeons are noticeably susceptible to this disease. Fancy breeds of chickens and pheasants and birds in zoological parks that have to be kept in confinement are more predisposed than those running at large. In birds the lesions are at times localized in the mouth, nostrils, or trachea, as well as in the bronchi, lungs, and air sacs; occasionally the liver, kidney, spleen, and peritoneal membrane may show small tubercle-like nodules, and in the center of their caseous contents the fungous filaments may be demonstrated.

REPORT OF CASE.

Our subject was that of a flamingo (*Phœnicopterus ruber*) which died at the National Zoological Park, Washington, D. C., on May 15, 1903, and was sent to this laboratory for an investigation as to the cause of its death. The bird was obtained near Las Tunas, on the southern coast of Cuba, and was received on April 25, 1903, by Dr. Frank Baker, superintendent of the National Zoological Park, to whom we are indebted for furnishing us the carcass of the bird. It had

therefore been in this country less than three weeks and was the fourth flamingo to die at the park in a short space of time, the other three not having been subjected to a postmortem examination. In this case the macroscopic appearance of the lungs was somewhat like the gross lesions of an advanced case of tuberculosis, and the carcass of the bird was very much emaciated. On opening the bird the sternum was carefully removed and the heart dissected away from its attachments; this left the lungs in full view. (See Pl. VI.) They presented a mottled appearance and the normal pink color was replaced almost in its entirety by grayish yellow areas from the size of a pinhead to that of a pea. These foci showed a tendency to coalesce, and were not infrequently surrounded by a hemorrhagic zone or area of diffuse or irregular consolidation. In the center of some of the large areas there was a dark pigmentation simulating anthracosis. The bronchial tubes on their lower surface each have an aperture opening into the suprasternal air sac, and through this opening could be seen a green velvety membranous lining covering the mucous membrane; it was this peculiar appearance that suggested to us the nature of the trouble. An incision was made into the bronchus and a scraping of the material mounted in glycerine was examined with a high-power lens of the microscope. As was suspected, it proved to be masses of mycelia and the sporulating fruitheads of an aspergillus, which was afterwards demonstrated morphologically and by cultural tests to be the *Aspergillus fumigatus.* The macroscopic appearance of the liver, spleen, and kidneys was apparently normal, but the heart was greatly hypertrophied. In the intestines there were several nodules which were examined for the presence of mycelia but without finding any. All of the lung tissue was saved, and many sections showing the intense and very interesting alterations due to the presence of the fungus have been procured. Unfortunately, none of the tissues other than the lungs were preserved for sectioning, so that a description of the microscopic appearance of these organs, as produced by the spontaneous disease, can not be given. Culture media inoculated from the lungs gave an abundant growth of the aspergillus, but contaminated with a growth of an organism which proved to be the bacterium pyocyanea. A pure culture of the fungus was obtained on potato and glycerine agar from the spleen and kidney, which indicated an extension of the disease from the lungs. In Allbutt's System of Medicine the statement is made that aspergillosis never becomes generalized, but this probably has reference to the observation of the affection in man. In July, 1903, however, Ceni reported the generalization of the aspergillus infection in twenty-one out of twenty-eight persons affected with pellagra.

Concerning the symptoms of the disease in this particular flamingo very little can be given, as it was in the possession of the Zoological

Park for only twenty days and was evidently infected before its arrival. During this short period it showed a capricious appetite and appeared to be very much dejected, standing about in a listless manner. The plumage was dull and the wings were pendant. Emaciation was not apparent until death occurred.

SYMPTOMS IN BIRDS.

In the beginning of the affection there will probably be nothing shown, and it is only after development of the fungus in the bronchi that a difficulty in breathing manifests itself. The birds become listless, mope, and do not follow the rest of the flock. When made to run they soon become exhausted and fall and have great difficulty in breathing. Even when not disturbed they appear very weak and gasp for breath, extending their heads and making movements as if choking. There is great thirst, but a diminution or complete loss of appetite. The birds become rapidly emaciated, the wings are pendant, the eyelids droop, comb and wattles become quite pale, and a general dejected appearance follows. Usually there is an intense diarrhea which weakens the bird very much. In the experimental disease the diarrhea is an accompaniment just as in that of a spontaneous development. The plumage is said to appear ruffled, and the respirations become croupy, even when the disease has not advanced very far; later they are more rapid and a rattling noise can be heard. In the final stages suffocation is threatened.

When the air sacs are affected very few symptoms manifest themselves, though emaciation is marked. As in any similar condition of the lungs, fever is high, and symptoms that would be manifested in pneumonia of fowls would, of course, show here. There is more or less catarrh of the trachea and bronchi, and if these alone were affected there would probably be nothing to attract notice other than symptoms of bronchitis. Bleeding from the nostrils has been observed in man and in animals, and it may be that this would also occasionally be seen in birds. If the air spaces in the bones become affected, lameness with swelling of the joints may result. The duration of the disease is quite variable and death may take place in from one to eight weeks from asphyxia or marasmus. Duration depends a great deal upon the portion of the respiratory apparatus that is affected; if the aspergillar nodules were localized in the mouth, as it is sometimes in pigeons, or in the bones or air sacs, the duration of the disease would, of course, be much longer than if in the bronchi or lung substance.

ETIOLOGY.

A short description of the *Aspergillus fumigatus* with a few remarks on its manner of growth will make clearer the microscopical alterations produced by this fungus. It will grow readily and quite satisfactorily on

sterile potatoes, not quite so well on plain agar or on gelatin, which it liquifies, and most slowly on the surface of plain bouillon. The medium in any case should be acid in reaction for its best development. A slice of rye bread placed in a large petri dish, moistened with water, and sterilized has been found to be an excellent medium upon which to grow this fungus, and for the simple study of the manner of growth nothing could be more handy. However, growth on Raulin's fluid is said to be the ideal way to study it in all its phases. This is a complex formula of mineral salts in water, but has the advantage over the solid media in that growth appears to be much more rapid, spore formation taking place within fourteen hours when kept at a temperature of from 37° to 39° C. Our own experience does not warrant such a statement, as greater difficulty was encountered in obtaining a good growth on this medium than on potato or rye bread. About twelve to eighteen hours after sowing some spores on potatoes, bread, or in the Raulin fluid a white, downy growth occurs which is composed of an interlacing mass of transparent threads, some (known as the thallum) penetrating into the nutrient media, the others forming a downy, felted mat called the aerial mycelia. The aerial filaments give off here and there vertical branches differing from the others in not having internal partitions and which terminate in a hemisphere 8 to 20 μ in diameter. (See Pl. VII.) Upon the surface of this hemisphere a number of closely adapted spurs are placed 6 to 10 μ in length, known as sterygmata, and, finally, from the ends of these sterygmata are given off rows of radiating conidia, or spores, 2.5 to 3.5 μ in diameter, forming what is called the capitulum. These little colorless globular spores are formed by a constricting process, and it is to the dissemination of them in the bronchial tubes that new centers of infection arise. When the aerial hyphæ begin to send off the fruit-bearing shoots, the color begins to change from the white, cottony growth to a blue green (see Pl. X, fig. 2), then to bronze green; finally, in old cultures, to a decided brown color.

The optimum temperature for the *Aspergillus fumigatus* is from 35° to 40° C. Spores do not form below 20° C. They are found in their natural state, widely disseminated, growing upon dead organic matter and on grain, straw, and similar substances. They are very tenacious of life and are able to conform to various conditions of existence. In moldy, stacked hay and in germinating barley the fungus can bring the temperature up to 60° C. It is most readily classified by the appearance of the fruiting heads and especially by measurement of the spores, which are from 2.5 to 3.5 μ in diameter. Reliance on the color of growths in culture media is unsatisfactory, as it resembles several other species very closely. Botanically it belongs to the family Perisporiaceæ, and order Ascomycetes, so named because they form their spores by partial divisions in the interior of the tubular mother cells. These

spores can withstand a temperature of 65° C. for seven hours, and are destroyed by a 5 per cent solution of carbolic acid or chloride of zinc only after an exposure of twelve hours. They can retain their vitality in a dried condition for many months—in fact, as long as four years—and when placed under suitable conditions will germinate readily. Thus it is seen that they may be a menace to poultry almost as long as they remain in a dried condition about the premises.

PATHOLOGICAL ALTERATIONS.

From cultural tests it was shown that the disease in our subject was generalized, although on gross examination the lungs were the only organs apparently affected. The macroscopic examination of these organs disclosed a picture simulating the gross appearance of an advanced case of pulmonary tuberculosis, with the exception that the bronchial tubes were almost completely plugged with a greenish velvety membranous lining.

Before describing the microscopic findings it may be well to mention that the lungs of birds, instead of being freely suspended in the thoracic cavity, are fixed to the dorsal region of the spine and occupy the intercostal hollows, which causes a singular notched appearance to their superior surface. The primary bronchi, after forming a slight dilatation called a vestibule, pass backward to the posterior extremity. They are disposed on the inferior surface of the first third of the lung, where they penetrate, branching as they go, and ending in the air sacs. The primary branches of the bronchial tubes give off secondary branches, and these in their turn give off tertiary branches. These finer branches open upon a dense network of minute, almost naked, blood vessels, through the delicate walls of which oxygen is obtained. The tertiary branches are convoluted, as if by constricting bands, which form imperfect septæ, and it is in these spaces that blood vessels are placed, bringing them in close contact with the air.

In the secondary bronchi and in the cavernous tertiary bronchi of the flamingo much fibrinous exudate is seen. In its substance threads of mycelia penetrate in every direction, often being disposed in a festooned arrangement upon the septal convolutions. In the bronchial divisions not wholly occluded by the croupous exudate are seen the characteristic aspergillar fruitheads in various stages of development, from that of a slight bulging end of the hypha to those giving off their spores. Included within this alveolar exudate are quite a few leucocytes and red blood cells, but their presence is by no means constant. The bronchial mucosa is often eroded and the lining epithelium replaced by a fibrinous coagula or by a membranous material composed of matted mycelial threads from which hyphæ extend into the air space, forming spore-bearing fruitheads, owing to the presence of oxygen. (See Pl. VIII.) The submucous tissue is permeated by

mycelial filaments, and leucocytes and round cells have literally "lined up" in their endeavor to check the invasion of the fungus. However, in this case the effort seems to be futile, as not only the submucous tissues are invaded, but the deeper structures as well. In fact, penetration of the walls of the injected blood vessels can be easily demonstrated. (See Pl. IX, fig. 2.) The resulting thrombi are impregnated also by the mycelial elements. Hemorrhage into the surrounding tissues, due to the weakening and destruction of the continuity of the vessel wall, is a frequent picture in some of the sections studied. The capillary blood vessels nearly all show perivascular aggregations of lymph cells. The various coats of the arterial walls of those vessels in which penetration has taken place are swollen asunder by an abundant sero-fibrinous exudate rich in round cells and leucocytes. Wherever the mycelial threads are found penetrating a new area, there, too, is found a marked leucocytic disturbance, but apparently in most cases this offers but a very ineffective barrier to the encroachment of the fungus. In several sections examined there appeared an occasional circumscribed area with a necrotic center and at its outer margin radiating mycelial filaments resembling clusters of the ray fungus (actinomyces). Between this outer zone and the surrounding healthy tissues evidence of tissue defense is manifested by a belt of round cells and new connective tissue elements. This was the nearest approach to tubercle formation in this case, which, however, was far advanced. No giant cells could be made out.

In animals in which the disease was experimentally induced by the injection of the spores into the blood vessels or into the lung substance, miliary lesions resembling tubercular formations were quite noticeable in the lung tissues, and in these an occasional giant cell was discovered. In the lungs of a chicken which was inoculated directly into the lung substance an acute miliary pseudo-tuberculosis was produced, accompanied by intense hemorrhages into the interstitial tissues, as was also the case in intravenous inoculations. In these tubercular nodules penetrating filaments could be made out, but the spores could not be surely demonstrated, or at least differentiated from other cellular elements. Often the bronchial ramifications were the seat of hemorrhage, in which a noteworthy increase in the number of leucocytes could be observed.

In the experiment animals the kidneys showed by far the greatest amount of alteration. In all cases the blood vessels were engorged, their lumen being so distended as to give at first the impression of an interstitial hemorrhage, while extravasated red blood corpuscles were not infrequently observed throughout the parenchyma of the organ. At various locations in both cortical and medullary portions were seen deeply stained areas composed of infiltrated leucocytes and proliferated embryonic cells, the greater part of which were irregular in shape,

especially toward the center of the foci. When the youngest of these tubercles were examined, after treating the sections with caustic potash and staining with aqueous methylene blue, mycelial filaments could be detected in the midst of this pronounced cellular invasion. In tubercles of longer duration these filaments could not be observed, owing to their obscuration, by the infiltration of leucocytes, epithelioid cells, degenerated renal cells and their fragmented nuclei. Multinucleated cells were at times detected in these areas of necrosis. A tendency toward regeneration was occasionally manifested by the appearance of embryonic elements and connective tissue cells arranged concentrically in the periphery of the tubercles. In such instances the surrounding renal tissue appeared normal, but if the lesion was progressive, degeneration of the surrounding cells was indicated by their swollen granular appearance and by their faintly stained or unstained nuclei.

In the liver of the experiment animals there were minute circumscribed or irregular aggregations of cellular elements interposed in the liver lobules between the rows of hepatic cells or involving the latter themselves. A disintegration of the liver cells in these foci was taking place and the nuclei showed more or less fragmentation. Migrated leucocytes were present together with nucleated round cells. These nodules in most cases were not sufficiently degenerated to give the typical appearance of tubercles, but rather suggested the advancing stage of coagulation necrosis. No giant cells were observed. It was with difficulty that filaments could be made out in these foci, but they were finally demonstrated by aqueous methylene blue following caustic potash treatment and by Weigert's fibrin stain. The liver cells immediately around these areas were either normal or exceptionally in the condition of cloudy swelling. There was also occasionally noted slight fatty infiltration of some of the hepatic cells in the immediate neighborhood of the portal spaces.

TECHNIQUE.

In the histological study of the above-described lesions the tissues were fixed in gradually ascending strengths of alcohol, cleared in xylol, infiltrated and embedded in paraffin, and cut in serial sections. The stains employed in bringing out the distribution of the fungus and the pathological alterations consisted of hydrochloric-acid carmine counterstained with gentian violet, methylene blue and eosin, lithium-carmine and Weigert's fibrin method, hematoxylin and picro-fuchsin, Gram's stain and eosin, and hematoxylin and eosin, the first three agents mentioned producing the most excellent results. In demonstrating the mycelial elements in tissues treatment with caustic potash solution, followed by aqueous methylene blue, was found highly satisfactory.

PATHOGENESIS.

In our experiments to ascertain the pathogenicity of the *Aspergillus fumigatus*, chickens, pigeons, rabbits, and guinea pigs were used, the greater proportion of which succumbed to aspergillosis as a result of the injection.

EXPERIMENTS WITH CHICKENS.

Mature fowls were inoculated intratracheally, intravenously, and intrathoracically. The following case will give an idea of the results obtained by the intravenous method:

On May 28, Chicken No. 12 received in the wing vein 0.5 c. c. of a suspension of spores in a physiological salt solution. It became languid after six hours, refused its food, and died within twenty-four hours. Culture media was inoculated from all the tissues and growths of the aspergillus were obtained from the heart, liver, and spleen, although macroscopically no lesion in any organ could be discerned.

A smaller dose (0.25 c. c.) of a similar suspension of the aspergillus spores when injected into the wing vein of chickens did not produce death until three to five days. In these cases the birds became dull and listless in twenty-four to forty-eight hours, refused to eat, but drank copiously of water, and died within five days from the time of inoculation. On postmortem examination the carcasses appeared to be feverish, the lungs were injected and at times contained diminutive areas of necrosis. The liver and kidneys, and occasionally the spleen, also showed these small foci of degeneration sprinkled throughout their parenchyma. From these tissues the aspergillus was recovered in pure culture. On October 15 a hen was injected intrathoracically with 0.25 c. c. of saline solution of spores. The bird became ill on the following day. Diarrhea set in, accompanied by great thirst, and on the fourth day following death occurred. On postmortem examination the lungs contained isolated and diffused tubercles surrounded by hemorrhagic zones. The liver, spleen, and kidneys likewise contained small pin-pointed foci from which the specific fungus was recovered. The chicken inoculated intratracheally with 0.25 c. c. of a similar suspension on May 28 remained apparently well, and when killed six weeks later no indication of the disease could be detected either macroscopically or microscopically.

EXPERIMENTS WITH PIGEONS.

On October 17 a pigeon was injected with 0.75 c. c. of a bouillon suspension of spores of the aspergillus into the trachea. This bird died four days later with a local caseous pneumonia, due to the development of spores in the lungs. The infection had extended to the kidneys and peritoneal membranes, causing small yellowish caseous nodules about the size of a pin head and containing masses of mycelial threads.

Pigeon No. 2 was injected into the wing vein with 0.25 c. c. of a suspension of spores in bouillon. Two days later the bird was found dead. The postmortem examination showed the liver and lungs to be very much congested and the spleen soft, swollen, and injected, but no areas of necrosis were observed. Cultures were obtained from the lung and spleen.

Two other pigeons were fed on three successive days with a bouillon suspension of spores amounting to 10 c. c. daily. This was placed on their grain and was consumed without causing them any apparent inconvenience. When chloroformed eight weeks after their exposure no alterations were discernible and media inoculated with juices of the tissues remained sterile.

EXPERIMENTS WITH RABBITS.

Rabbits Nos. 1007 and 1008 were inoculated intraabdominally each with 0.5 c. c. of a saline suspension of spores from a seven-months-old potato culture of *Aspergillus fumigatus*. The former animal appeared well and retained its appetite until the seventh day, when it was observed to be depressed and refused to eat. The animal gradually grew worse and died on the ninth day after becoming so weakened as to lie prostrate for five hours before its death. Postmortem examination showed a well-marked case of aspergillosis. The lungs were invaded with three foci in the principal lobe of the left lung, and four nodules on the apex of the right lung. The heart and pericardium were apparently normal. The peritoneal surface of the diaphragm was sprinkled with small transparent glistening nodules varying in size from a mere speck to a celery seed. The liver contained numerous pin-point areas of necrosis. The spleen and kidneys showed numerous well-scattered, elevated, and circumscribed nodules strongly suggestive of tuberculosis. The pancreas was likewise covered with little pin-point areas of necrosis. The right testicle showed three irregular or raised nodules on the tunica vaginalis. The omentum, mesentery, parietal peritoneum, and serous lining of the intestines were thickly sprinkled with minute transparent dew-like elevations. The most interesting feature connected with this autopsy was the finding of several circumscribed yellowish white foci about the size of a mustard seed in the adductor muscles of the left hind leg. Culture media inoculated with the affected organs gave luxuriant growths of the specific fungus.

Rabbit 1008 failed to show any marked symptoms for the first two weeks after inoculation. It then began to lose weight, and on the twenty-fifth day was chloroformed. The postmortem examination showed an involvement of the liver, spleen, kidneys, and abdominal serous membranes, as in the preceding rabbit, but to a less extent. The organs of the thoracic cavity were apparently normal.

DESCRIPTION OF PLATE VI.

Pneumonomycosis in the lung of a flamingo caused by the *Aspergillus fumigatus*. (Natural size.)

DESCRIPTION OF PLATE VII.

Cover-glass preparation of the *Aspergillus fumigatus*, forty-eight hours old, taken from the surface of dextrose bouillon and mounted in glycerine. Enlarged twice the original when drawn opposite base of stand with the camera lucida, using Zeiss 8 mm. objective and No. 4 compensating ocular.

DESCRIPTION OF PLATE VIII.

Section from lung of flamingo stained with hydrochloric-acid carmine, and gentian violet. Camera-lucida drawing made with Zeiss 8 mm. objective and No. 4 compensating ocular at the base of stand. Notice the fruit heads and free spores in the bronchus, the lining membrane of which is completely eroded and replaced by matted mycelial threads of the fungus.

DESCRIPTION OF PLATE IX.

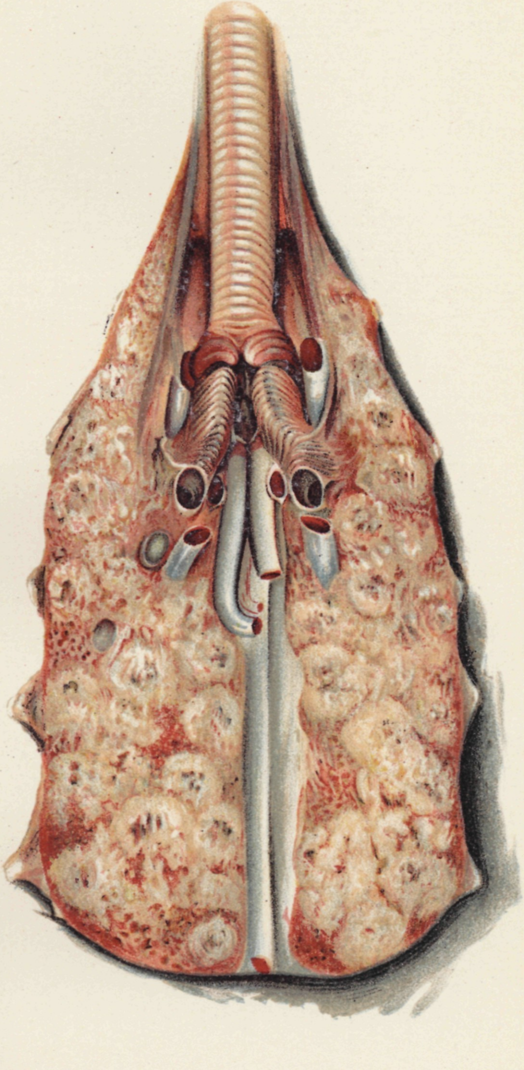
Fig. 1. Section from lung of flamingo stained with methylene blue and eosin. Camera lucida drawing made with Zeiss 8 mm. objective and No. 4 compensating ocular at the base of stand. Notice the marked absence of cellular exudate in the bronchus. Fruit heads and free spores are shown in the air space, a fibrinous coagulum along its wall, and mycelial filaments penetrating the pulmonary tissue, which shows pronounced cellular invasion.

Fig. 2. Section from another portion of the same lung stained with methylene blue and eosin. Camera lucida drawing made with Zeiss 16 mm. objective and No. 6 compensating ocular at stage level. Mycelial filaments are observed penetrating the walls of the blood vessel, producing a thrombus, in which many leucocytes and fungous elements may be detected.

DESCRIPTION OF PLATE X.

Fig. 1. Six-day-old culture of *Aspergillus fumigatus* on potato, showing the vigorous character of growth and its bluish green tint at this stage of development. (Reduced one-fourth.)

Fig. 2. Aspergillar tubercles in the kidneys and suprarenal capsules of rabbit No. 850, which died on the tenth day following the intravenous injection of the spores of the fungus. (Natural size.)



PNEUMONOMYCOSIS, LUNG OF FLAMINGO.

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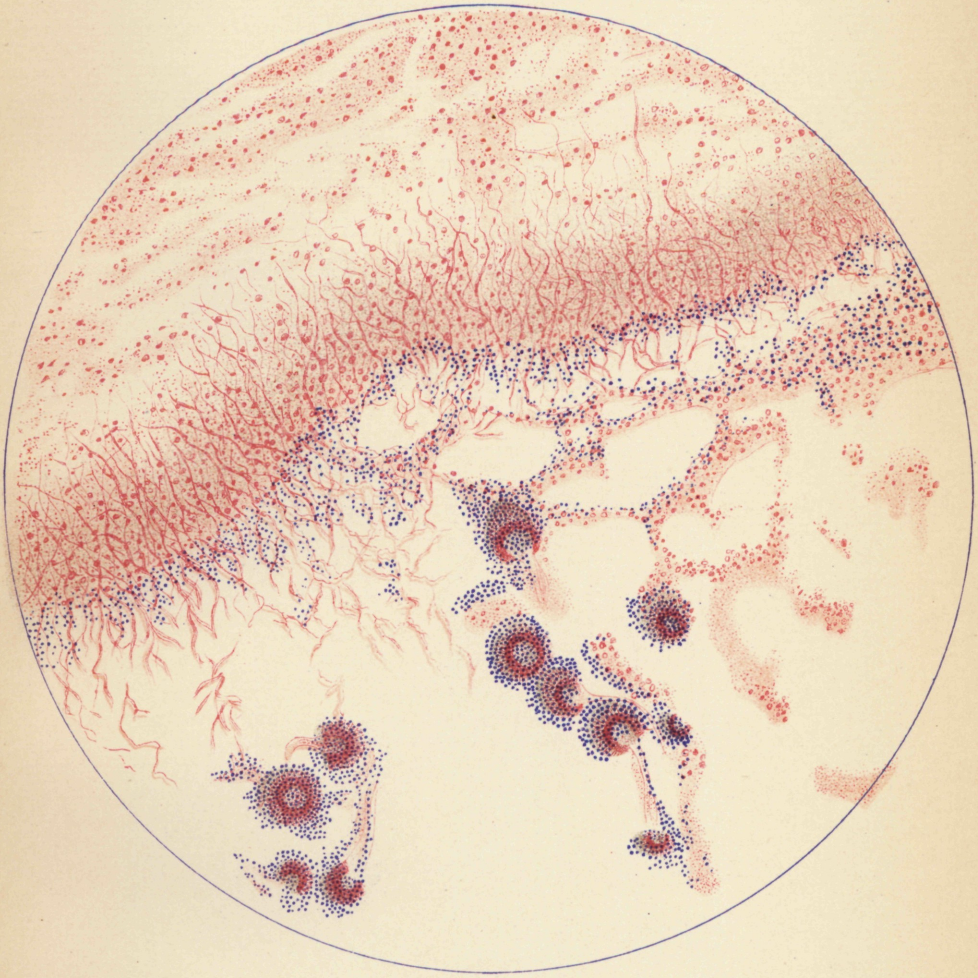
Haines, del.

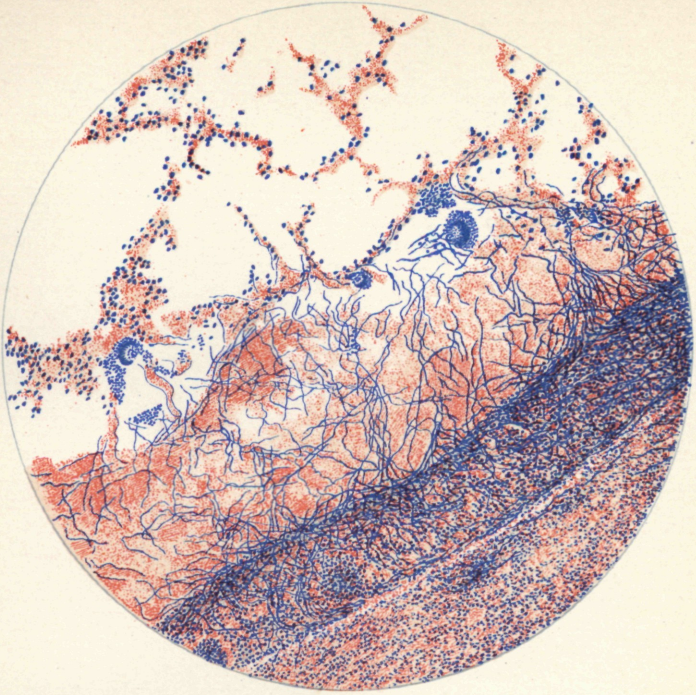
BREUKER & KESSLER CO. PHILADA

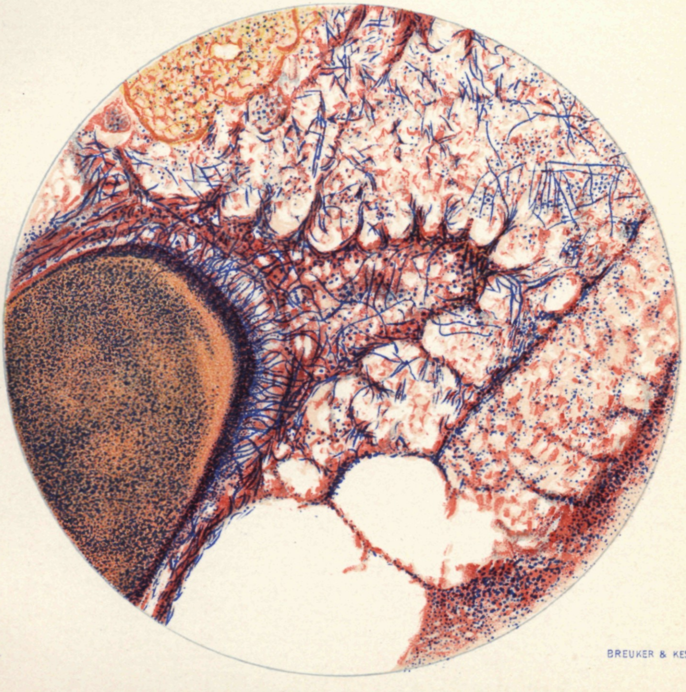
ASPERGILLUS FUMIGATUS.



Haines, del. BREUKER & KESSLER CO. PHILADA

ASPERGILLUS FUMIGATUS IN LUNG OF FLAMINGO.





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SECTIONS OF NODULES IN LUNG OF FLAMINGO.

FIG. 1.

FIG. 2.

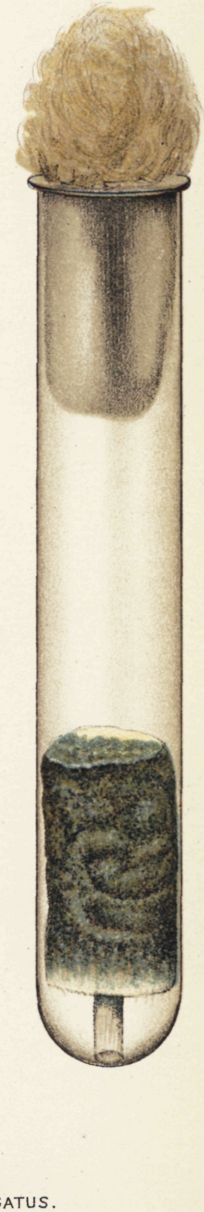

FIG. 1.—EXPERIMENTAL ASPERGILLOSIS IN RABBIT.
FIG. 2.—POTATO CULTURE OF ASPERGILLUS FUMIGATUS.

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BREUKER & KESSLER CO. PHILAD^A

Rabbits 850 and 592 were inoculated intravenously with 0.25 c. c. of a suspension of aspergillus spores and died in ten and thirteen days, respectively. Both of these animals showed pseudotubercles in the lungs, liver, and kidneys, and in No. 850 the suprarenal bodies were involved. (See Pl. X, fig. 1.) The lesions in the kidneys were quite characteristic, the nodules in the cortical portion standing out prominently on the surface of the kidneys as distinctly defined tumors or tubercles from 1 to 3 mm. in diameter and of a yellowish white color. Cultures of the aspergillus were recovered from these animals.

This species of animal was also used in testing the action of the filtered product of the *Aspergillus fumigatus*. These experiments with the toxin of this fungus produced by growing for ten days on Raulin's fluid confirm the work of Obici and others in that the inoculation of the filtrate caused only a transient indisposition and slight increase of temperature.

EXPERIMENTS WITH GUINEA PIGS.

Ten guinea pigs were inoculated with the spores of the aspergillus by various methods.

Three guinea pigs were inoculated each with 0.3 c. c. of a suspension of spores directly into the thoracic cavity and died on the tenth, fourteenth, and seventeenth days, respectively. The postmortem examination showed aspergillar pneumonia, with several tubercles on the pleura. In the first instance a hemorrhagic fringe of fibrous tissue was present on the parietal pleura of the injected side. The diaphragm in each case likewise contained one or more nodules. The livers were sprinkled with diminutive necrotic foci throughout their parenchyma. The kidneys and spleens were normal. Cultures of the fungus were obtained from the liver and lungs.

Three guinea pigs were injected subcutaneously in the left thigh each with 0.5 c. c. of a spore suspension. Two of the animals became lame in the injected leg, but otherwise remained healthy, and when chloroformed twenty-five days later the only alteration observed was about the seat of inoculation. At this point a greenish colored caseous mass was the center of tissue necrosis, involving the surrounding muscular tissue, from which the fungus was recovered on potato media. The third guinea pig was also chloroformed at the same time, but no lesions were found which would indicate aspergillus infection. The two guinea pigs that were inoculated with 0.5 c. c. of a similar suspension intraabdominally remained healthy and when chloroformed, twenty-nine days after their injection, revealed a perfectly normal condition. Culture media inoculated from the various tissues of these animals did not become fertile. The remaining guinea pigs in this series were injected with 0.3 c. c. of the spore suspension intratracheally. Death followed in one case on the third day, with lesions of caseous pneumonia, from which the aspergillus was readily recovered.

The other animal failed to show any ill effects from a similar injection and was perfectly healthy when chloroformed, twenty-five days after its exposure.

DIAGNOSIS.

To diagnose this affection in birds during life is scarcely possible, unless some of the lesions are located in the mouth or upper respiratory passages. On postmortem examination the alterations may resemble tuberculosis or an affection known as acariasis, caused by the animal parasite (*Symplectoptes cysticola*). A differential diagnosis can readily be made by a microscopic examination of the contents of the nodule and the demonstration of the mycelial filaments. When the bronchial mucosa is affected with mycosis it is very easy to find these filaments and possibly the fruitheads. If the affection is confined to the lung tissues it would be advisable to crush one of the nodules, inoculate a sterilized potato, and incubate twenty-four to forty-eight hours, when it will be possible not only to diagnose the affection, but to say which variety of aspergillus one is handling.

PREVENTION.

In an outbreak of aspergillosis in chickens or other birds the only hope is in prevention, and this will consist in the destruction of the spores about the premises or in discarding contaminated grain or other foods. The buildings and yards should be cleaned thoroughly and the buildings disinfected by the liberal use of fungicides in the form of washes of whitewash to which has been added 5 per cent carbolic acid. The yards may be sprinkled with freshly burned quicklime or chloride of lime. The drinking and feeding dishes should be kept thoroughly cleaned. Affected birds should be separated from the flock, and all dying from the affection should be buried or burned.

TREATMENT.

Medicinal treatment is probably of little efficacy. If a large number of birds are affected at one time, or if those affected are very valuable, treatment may be tried in the form of medicated vapors, such as those generated from wood tar or sulphur. A small quantity of wood tar is put in a pint of water and stirred with a red-hot iron. The person doing the fumigating should remain in the room and immediately remove any birds that are overcome by the vapors. Burning sulphur or vapors of formalin may be tried in like manner. Hydrogen peroxide, solutions of potassium iodide, or hyposulphite of soda may be used as intratracheal injections, and in case of local nodules in the mouth or nostril the tincture of iodine may be applied to them with beneficial results.

INVISIBLE MICROORGANISMS.

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A REVIEW OF THE SITUATION.

Fifty years ago the nature of infectious diseases was just beginning to be understood. The then existent beliefs concerning the origin of infectious diseases rested almost entirely upon a theoretical basis, and it was not until the beginning of the era of experimental medicine, in which movement Pasteur was the great leader, that any headway was made in the solution of those problems which were finally so brilliantly worked out by Pasteur and his collaborators of that period. The existence of bacteria and other microscopic forms of life had been recognized for more than a century when, in 1850, Pollender and Davaine made their observations upon anthrax, their work being the first experimental evidence of the fact that certain forms of bacteria occupied a causal relation to particular infectious diseases.

During the period between 1850 and 1875 the controversy regarding the spontaneous generation of microorganisms was the all-absorbing topic among biologists, and although this debate did not include the etiology of infectious diseases it involved questions, such as the cause of fermentation, which were so closely allied that the methods employed in the study of the one were in great part applicable to the other.

Thus it was that the foundations of our present-day bacteriological technique were laid, and when, in 1881, Koch gave to the workers in bacteriology his solid-culture media and his "plate method," the principles of sterilization and the methods of staining were already well understood. It is no wonder, therefore, that the decade following Koch's announcement of the "plate method" of isolating bacteria in pure culture was notable for the great advances made in experimental medicine, and especially in that branch of it which concerns the etiology of infectious diseases.

Notwithstanding the many notable advances in that period, however, the causative agents of a certain number of human and animal diseases completely escaped discovery. New and supposedly favorable culture media were prepared; microscopes were improved in every detail of construction; new staining methods were devised; and, in fact, everything was done which might aid in determining the infectious agents in such diseases as measles, scarlatina, smallpox, rabies, bovine pleuro-

pneumonia, foot-and-mouth disease, rinderpest, and others of almost equal importance, and yet, as has just been stated, even at the present time we are almost entirely in the dark with regard to the etiology of the above-mentioned diseases.

In the year 1898, however, a number of important observations were made which were of such a nature that they seemed to give us a glimpse of an unknown world of infinitesimally small creatures whose existence had previously only been surmised.

It is with the idea of describing somewhat briefly the original discoveries and those which have followed them that this paper is written.

FOOT-AND-MOUTH DISEASE.

Foot-and-mouth disease is one of the most contagious maladies known to veterinary science, and has caused enormous losses to stock owners in Europe. Primarily it affects cattle, though few, if any, of the domestic animals are exempt, and is characterized by fever, loss of appetite, and emaciation, the last two symptoms being in large part due to the development of vesicles in the mouth, which cause swelling and tenderness of the buccal mucous membrane. Vesicles appear on the udders of cows and on the skin surrounding the hoofs. The mortality from this disease among affected cattle probably averages 1 or 2 per cent, though it may be very much greater. The chief loss, however, is to be noted in the general condition of the herd, which is, as a rule, 30 per cent poorer than before the attack of the disease.

In 1898 Loeffler and Frosch presented to the German Government a report of the results which they, as a commission, had obtained from their investigations of foot-and-mouth disease. They showed that the fluid contained in the buccal vesicles of affected cattle was extremely infectious, and that a very small amount of such material, when in a fresh state, sufficed to bring about typical attacks of foot-and-mouth disease in cattle and hogs, and this notwithstanding the fact that they were unable, even after the most careful search, to ascertain the existence of any microorganism whatever in certain lots of this fluid, either by staining or by culture experiments. Knowing, however, by experience that the infectious agent was present, and being desirous of obtaining some method of producing immunity, they conceived the idea that the filtered lymph from an animal in the acute stage of foot-and-mouth disease might be used for this purpose with advantage, the object of the filtration being to separate all the corpuscular elements from the soluble portion, the latter to be used for the production of immunity. With this idea in view, therefore, a certain quantity of virulent lymph, to which was added 39 parts of water, was passed repeatedly through a filter (Berkefeld) of infusorial earth. Before the filtration, however, a considerable amount of a culture of *Bacil-*

lus fluorescens was added to the diluted virus in order that that bacillus might serve as a check on the efficacy of the filter. The filtrate was repeatedly tested, but at no time did *B. fluorescens* or any other microorganism which could be recognized by cultural methods appear.

A number of calves were next inoculated with quantities of the filtrate which were the equivalents of from one-tenth to one-fortieth cubic centimeters of the original lymph. To the very great surprise of the experimenters, the calves that were inoculated with the filtered lymph sickened in the same length of time as did the control animals, which received a corresponding amount of unfiltered lymph, and, in addition, they exhibited all the typical symptoms of foot-and-mouth disease, such as high fever and vesicles in the mouth and on the feet.

In order to confirm, if possible, this very unexpected occurrence, the experiments were repeated a number of times on calves and hogs, and always with the same result when fresh lymph was used. Here, then, was possibly a new fact for bacteriologists to reckon with, for Loeffler and Frosch had in their filtrate either an extremely powerful toxin or an organism which passed regularly through Berkefeld filters, which were fine enough to hold back *B. fluorescens*.

In order to show that they were not dealing with a toxin, Loeffler and Frosch compared the disease-producing power of their lymph with the most powerful tetanus toxin that had ever been reported, and found, according to calculations based upon the body weight of the animals and the amount of virus used, and taking into consideration the transference of the disease from an animal treated with filtered lymph to others, that if the disease produced by the filtered lymph was due to a toxin it was by far the most powerful ever known, its toxic value being 1:2,500,000,000,000. Such an extremely toxic substance is inconceivable, and, besides, we know of no disease which may be induced by one-fiftieth cubic centimeters of toxin and then be carried successively through six animals, using continually the same minute dose. It would therefore seem to be reasonably certain from the original experiments of Loeffler and Frosch that they had a living micrcorganism in their filtrates, and that this microorganism passed through the Berkefeld filter. More recently Loeffler has stated that, while the virus of foot-and-mouth disease passes through Berkefeld filters, it is retained by the finer-pored Kitasato filter, thus definitely disposing of the idea that the infecting substance may be in solution.

BOVINE PLEURO-PNEUMONIA.

Within a very short while after the publication of the researches of Loeffler and Frosch, the paper of Nocard and Roux upon the etiology of bovine pleuro-pneumonia appeared. The work of these French savants, done in collaboration with Borrel, Salimbeni, and Dujardin-

Beaumetz, was as remarkable in its way as was the work of their German colleagues, for they not only brought forward an entirely new principle in the cultivation of microorganisms, but by means of this new method they were able to demonstrate positively the existence of a microorganism, which is certainly on the very border line which separates the visible from the invisible—the microscopic from the ultramicroscopic.

Bovine pleuro-pneumonia is an infectious disease of cattle which, by reason of its infectiousness and virulence, has been a source of great loss to cattle owners wherever it has existed. The disease is characterized especially by a serous exudate into the pulmonary interlobular tissue. It is quite infectious, and the mortality produced by it is considerably greater than that of foot-and-mouth disease. It is easily transmitted experimentally from one animal to another by subcutaneous inoculation. Where such an inoculation of a susceptible animal is made great swelling of the surrounding tissue follows, and this is accompanied by fever. In this subcutaneous effusion it is impossible to see any microorganisms, and cultures made from it in the usual way remain sterile.

The collodion-sac method of cultivating microorganisms *in vivo*, which was originated by Metchnikoff, has been most successfully employed by these authors in the following way: Thin sacs of collodion containing sterile nutritive bouillon were inoculated with a minute quantity of the serous effusion of bovine pleuro-pneumonia. These sacs, after being hermetically sealed, were introduced into the peritoneal cavity of rabbits. Fifteen or twenty days later the rabbits were killed and the unbroken sacs removed. The bouillon contained in them, instead of being perfectly clear, as it had been at the time it was introduced, was found to be opalescent. A collodion sac containing the same bouillon not inoculated was put into another rabbit at the same time and remained clear. When the above-mentioned opalescent culture fluid was examined microscopically with a magnification of 2,000 diameters and with an extremely powerful illumination, numberless extremely minute motile points could be made out. These remarkably small bodies are now generally conceded to be the cause of bovine pleuro-pneumonia. They are of such very small size that it has never been possible to determine definitely anything in regard to their form, even after they have been stained.

As proof that they were dealing with a living virus, Nocard and Roux could rely upon the motility of the bodies which they found, and also more firmly upon the fact that they were able to propagate their organism in successive collodion-sac cultures, and finally by the use of specially prepared culture media they were able to obtain and transfer indefinitely cultures *in vitro*, and with these cultures they produced typical attacks of pleuro-pneumonia in cattle.

It is very interesting to note the effect of their collodion-sac cultures

upon the rabbits. Those rabbits which received the sacs inoculated with pleuro-pneumonia became emaciated, some of them even dying on the fifteenth or twentieth day. Those rabbits which received uninoculated sacs of bouillon remained perfectly well. As rabbits are entirely refractory to inoculations with the virus of pleuro-pneumonia made in the ordinary way, this experiment seems to show that they may be susceptible to the soluble toxins generated by this microorganism, although they are capable of overcoming the living virus, provided it is not protected in some such way as by the collodion sac. In other words, we have in the behavior of the rabbit toward pleuro-pneumonia an instance of an animal which is immune from the body of the microorganism, but susceptible to its toxins.

In a paper published about a year later Roux and Nocard announced that they had been able to filter the diluted pleuro-pneumonia virus through a Berkefeld, and also through a Chamberland F cylinder, but were unsuccessful in their attempts to filter it through a Chamberland B, thus indicating that an organism need not necessarily be ultra-microscopic because it will traverse with regularity a Chamberland filter and a Berkefeld filter, they having previously shown by their successful cultures that the pleuro-pneumonia virus is just within the limits of visibility.

Since the researches upon pleuro-pneumonia and foot-and-mouth disease were published there have been many efforts to apply the principles there introduced to other diseases which had baffled all previous attempts to determine their cause. The majority of such investigations dealt with animal diseases, for the reason that they could be reproduced experimentally when it was desired to do so.

YELLOW FEVER.

First of all, concerning yellow fever, mention should be made of the epoch-making experiments of Reed, Carroll, and their associates. These investigators had already shown by a series of daring and conclusive experiments that yellow fever is transmitted only through the bite of a mosquito (genus *Stegomyia*), when, a little later, they announced the results of some filtration experiments with a Berkefeld laboratory cylinder. A certain amount of blood was drawn from the elbow vein of a man who was suffering from a mild attack of yellow fever. The serum which separated from the clot was diluted with an equal volume of sterile distilled water and filtered slowly through a Berkefeld laboratory filter which had been previously sterilized. The clot which remained was beaten up with distilled water. One nonimmune man inoculated with 0.75 c. c. of the aqueous extract of this clot developed a mild but typical attack of yellow fever. Three nonimmunes inoculated with double the amount of the same material, except that it had been previously heated to 55° C. for ten minutes, remained perfectly well. These two experiments showed that the

blood which was being used contained the true cause of yellow fever, and also that the virus, whatever its nature, was destroyed by an exposure for ten minutes to a temperature of 55° C. The filtered serum mentioned above, and which was derived from the same blood, was used for the inoculation of three other nonimmunes, an equivalent of 1.5 c. c. of the original serum being used for each inoculation. Two of these nonimmunes developed typical attacks of mild yellow fever as a result of these inoculations with filtered serum; the third one remained well. This nonimmune, who resisted the first inoculation as just noted, was subsequently inoculated with 1.5 c. c. of blood taken from one of the cases of yellow fever produced by filtered serum. As a result of the second inoculation he became typically ill with yellow fever. From the foregoing experiments, which, on account of their great importance, have been given in considerable detail, Reed and Carroll deduced the following conclusions concerning yellow fever: (1) The cause of the disease exists in the blood; (2) its vitality is destroyed by exposure for ten minutes to a temperature of 55° C.; (3) the virus is of extremely small size, as is shown by its passage through a Berkefeld filter.

As proofs that they had in their filtrates a living virus which was capable of multiplication, they quote their experiments showing that the thermal death point of the yellow-fever contagium is 55° C. for ten minutes. No known toxin will be destroyed by such an exposure as this. As proof that they were dealing with a virus which multiplied, they have the inoculation of the last nonimmune with blood from another who had been inoculated with filtered serum. Immediately after the filtration of the yellow-fever blood the Berkefeld filter which had been used was resterilized by steam and its effectiveness tested with cultures of *Staphylococcus pyogenes aureus*, and it proved to be entirely impervious to the above-named organism. The work of these American investigators has recently been entirely confirmed by the French yellow-fever commission, consisting of MM. Marchoux, Salimbeni, and Simond, who also conducted filtration experiments and found that in the serum from a yellow-fever patient the virus traverses a Chamberland F filter without dilution; the Chamberland B, under the same conditions, retained the virus. The microbe of yellow fever, being able to traverse a Chamberland F filter without dilution of the albuminous fluid in which it is contained, is probably of ultramicroscopic size. At least it seems likely that there are some forms of that parasite, as it exists in the human blood, which are too minute to be recognized even by our most powerful microscopes.

HORSE SICKNESS.

"Horse sickness," a South African disease of horses, is unknown in other parts of the world, although it has caused great destruction in that section of Africa. Horses chiefly are affected, though mules and

asses also contract the disease. The latter animals suffer from a milder form, and a few passages through them serve to weaken materially the potency of the virus. Summer is the time that the disease appears, and then chiefly in the low-lying districts, where the vegetation is abundant and the dews are heavy. Those animals that are allowed to run at large at night are especially liable to be attacked, while others of the same lot that are confined in stables remain well. The disease is not contagious, but may be transferred from one animal to another by subcutaneous inoculation of diseased blood. All of these peculiarities tend to indicate that the disease is induced by the bite of an insect, and probably a nocturnal one. The malady is usually described as existing in two forms—the lung sickness (dunpaardziekte) and the head sickness (dikkopziekte). Both forms are characterized by extensive serous exudations, an excess of such exudations in particular parts of the body being sufficient to classify the attack as of one form or the other. The attack usually begins with a moderate fever which shows an evening exacerbation. The lung symptoms develop very rapidly; there is difficult breathing, with the discharge of a faintly reddish tinged froth from the mouth and nostrils. Death appears to take place as a result of the plugging of the air passages by the extensive serous exudate. The form known as dikkopziekte, while exhibiting to a certain degree the lung symptoms, is characterized especially by extensive swelling of the head and neck. At the autopsy, in the pulmonary form, the lung tissue is found to be engorged with a serous exudate, and in the head sickness the subcutaneous tissues of the head and neck are distended with an exudate of a like character.

Most of the pioneer work concerning the etiology of horse sickness was done by Edington, who finally decided that it was caused by a mold which he found in the blood of all horses dying of this disease. Edington's idea, however, has very recently fallen into disfavor on account of the work of McFadyean and Nocard, whose experiments appear to place this disease also in the class with those caused by "invisible" microorganisms. McFadyean's experiments related chiefly to the filterability of the virus. He used a vacuum which varied from 26 to 29 inches and was applied to different filters. His filtrations proceeded slowly. In one instance, where serum was diluted with four volumes of water, twenty-two hours were required for the passage of 6 ounces of fluid.[a] McFadyean succeeded in passing the virus of horse sickness through a Berkefeld filter three times, through a Chamberland F four times, and through a Chamberland B one time. In all cases the filtered virus produced typical attacks of the disease in horses, but in no instance was he able to obtain a culture from these filtrates, they hav-

[a] There was here the possibility of microorganisms having grown through the filter.

ing always remained sterile. Since he succeeded in passing the virus through the Chamberland B cylinder, McFadyean believed the organism of horse sickness to be the smallest yet described.

Nocard does not agree with McFadyean in all respects. He describes one experiment in which he was able to filter the virus of horse sickness through a Berkefeld filter when the exudate was diluted in the proportion of 1 to 33 with river water. This filtrate produced typical attacks of the disease in two horses, although cultures from the filtrate showed no growth whatever. Nocard did not succeed in passing the virus through either the Chamberland F or B cylinders. Nocard states that he made many efforts to cultivate the microorganism of this disease, but all of them failed. He used liquid and solid media of many different kinds; cultures were made in vacuo, in the presence of oxygen or of inert gases; the collodion sac, with the use of which Nocard was of course perfectly familiar, was tried as a last resort, and was placed in the peritoneal cavity of many different species of animals, but always with the same result—the supposed microorganism refused to grow. One interesting fact brought out by Nocard is that virulent blood from a case of horse sickness may be sealed in tubes and kept in the dark at room temperature for more than two years without losing its infectiousness.

It will be agreed that in horse sickness we have a disease caused by a filterable virus. Its detailed characteristics have not as yet been made out.

BIRD PEST.

There is in Europe a highly infectious and fatal disease of chickens which has never been reported in this country, although it seems to be gaining quite a foothold abroad. It is generally admitted that the disease in question has existed in Italy for more than ten years, and the researches of Lode and Gruber and of Dubois show that it has more recently appeared in Belgium and in the Tyrolean Alps. There is much confusion in regard to the name for this disease, the terms "Vogel-pest," "Hühner-pest," "exudative typhus," and "*Kyanolophiea gallinarum*" having all been used by one or more writers. The name Vogel-pest or bird pest, as proposed by Centanni, seems to be sufficiently distinctive for our purpose, and it will be used in this paper.

It is to Centanni that the credit must be given for the first complete description of this disease and for the first description of the nature of the virus by which it is caused. This disease, which, according to Centanni, has been recognized as a distinct type for more than ten years, resembles chicken cholera, but does not correspond to it in all particulars. The symptoms of the disease may be summed up as follows: The chicken on the first day of illness appears to be somewhat unwell; on the second day it has ceased eating, the feathers

are ruffled, and the comb is darker in color; on the third day it is found dead or dying. The above is the usual course of the disease, but there may be instances in which the animal will live only a few hours, or, on the contrary, it may survive a week or more. The temperature just before death falls to 30° C. or less.

At the autopsy evidences of pericarditis are usually present, and there may be ecchymoses on the surface of the heart. There is usually some pleuritis. The lungs are more or less congested, this even extending at times to a pneumonic consolidation. The liver is enlarged and the spleen and kidneys are hyperemic. The intestinal lesions are never so severe as is seen in fowl cholera. Not all of the above lesions are, as a rule, found at one autopsy; indeed, in some instances nothing abnormal can be seen except a few congested areas scattered here and there in the various organs. The heart blood or aqueous extract of the lungs or liver almost invariably brings on an attack of the disease when a minute quantity is injected subcutaneously or when fed. Maggiora and Valenti found, after a large number of experiments, that 4 c. c. of a solution of virulent blood in which the blood was present in a proportion of 1:125,000,000, would destroy a young hen of 370 grams weight, and they intimate that, although they succeeded in causing the death of hens with such an extremely minute quantity of the virus, as noted above, this mark may be passed, and that no doubt blood will be found which will kill in even smaller doses. There is some variation in opinion in regard to the infectiousness of this disease for other fowls. Pigeons succumb to subcutaneous injections of the blood of diseased chickens, and by some authors there is said to be an unusual mortality among the wild birds in neighborhoods where the disease is prevailing. Guinea pigs and mice are not susceptible to the infection. Centanni regards rabbits as being subject to a kind of toxemia as a result of inoculation with large quantities of the virus. The infectious agent of this disease is very easily destroyed by heat, light, or drying. Maggiora and Valenti found that virulent blood allowed to dry spontaneously and kept in the dark for twenty-two days was still virulent, but in forty-two days its virulence had disappeared. In diffuse light the virulence was retained for fifteen days; in very bright daylight the virulence was lost in forty hours. The virus was destroyed by an exposure of one-half hour at 60° C.

Notwithstanding the above-described excessive virulence of the blood and body juices of chickens attacked by bird-pest, it has been impossible to isolate in pure culture any organism that is capable of producing this very destructive disease. Frequently the culture tubes remain perfectly sterile when the blood from which they were made is proved to be highly virulent. Cultures of a number of different organisms have been isolated by the several investigators, but each one has been finally proved to be only a contamination or a secondary

invader. The collodion-sac method was tried by Centanni, but without success. All attempts to discover the infectious agent in the blood and tissues by various methods of staining have proved futile. We are brought, then, to face another disease which seems to be due to an invisible microorganism.

Centanni and Maggiora and Valenti found that the virus retained its virulence after dilution and passage through a Berkefeld or a Chamberland F filter. According to Maggiora and Valenti, it will not pass through a Chamberland K. Dubois found that the virus passed through Chamberland filters, but the particular grade of filter is not mentioned. Lode and Gruber succeeded in passing the virus through Berkefeld filters only. Several authors record the passage of the filtered virus through four or more hens, successively, thus showing that the virus in the filtrate is capable of multiplication.

SHEEP POX.

There are a number of synonyms for this disease, the most important being clavelée and ovine variola. Sheep pox, in its general characters, resembles the smallpox of the human subject and is characterized by an eruption of small pustules, which may cover the entire cutaneous surface of the body. When infection of a flock takes place the disease spreads by regular stages called commonly the "moons." This is explained by the fact that a period of from twenty to twenty-five days is required from the time of infection until the infected animal becomes capable of communicating it to others,[a] and the moon, of course, has nothing whatever to do with the periodical advances of the disease in infected herds. In addition to goats and sheep, the disease may be communicated to dogs, pigs, horses, and cattle by inoculation. The virus is of great vitality and, when dry and protected from the action of light and air, will remain virulent an indefinite time. This explains the danger in sheepskins and wool. Any of the strong antiseptics suffice to destroy the virus. The disease has existed from time immemorial in the Mediterranean countries—Spain, Italy, the south of France, Algeria, and Tunis—all having the disease present in endemic form. Before the researches of Borrel, nothing very definite was known as to its nature. His first investigations consisted chiefly of filtration experiments. Material taken from a pustule and suspended in water was virulent even after an enormous dilution. Filtration of such diluted virus through a Berkefeld cylinder gave a filtrate which was sterile in so far as a visible growth of microorganisms was concerned, but which was still endowed with all the disease-producing power of the unfiltered material. Borrel then employed Chamberland filters of varying porosity with the following results. When the

[a] Borrel. Annal. de l'Inst. Pasteur, 1903. No. 11, Vol. XVII.

filtration takes place rapidly under pressure, the virus of sheep pox passes through a Berkefeld cylinder sometimes, but never through a Chamberland F. The Chamberland F_4, F_5, and so on to F_{10}, allow it to pass through always. The graded Chamberland filters were numbered F_2, F_3, F_4, F_5, etc., to F_{10}. The accompanying figures indicate that under identical conditions the filters so marked have a rate of discharge two, three, or, at the highest, ten times that of the ordinary Chamberland F. In all cases when cultures were made from the filtrate and incubated at 37° C. they remained sterile. If the dilutions are made with ordinary tap water, a certain number of very minute vibrios pass through the filter and develop at 20° C. In order to obtain the virus of sheep pox in a pure state it is sufficient to use boiled water in making dilutions. The filtrate will retain its virulence for a long time. Borrel considers that his researches show that the microbe of sheep pox is ultramicroscopic and that the cellular inclusions described as parasites of vaccinia, of variola, of clavelée can not be the true cause of the disease, and that researches upon smallpox and other allied diseases must be directed to the study of microorganisms, like those which cause peripneumonia and foot-and-mouth disease.

RINDERPEST.

This most fatal of all cattle diseases had its origin in Asia, though for centuries it has periodically ravaged Europe, and has also invaded Africa. Practically all ruminants are susceptible, but none contract the disease so readily as cattle, and cattle are also the chief agents in spreading the infection. Pigs show a slight susceptibility. The horse, dog, bird, and rabbit are immune, and man also. The death rate in cattle which have had no means of acquiring resistance to the disease is usually from 80 to 95 per cent. The disease is characterized by a high temperature and by lesions which are most extensive in the mucous membrane of the intestinal tract. The blood of infected cattle may be used to bring about an attack in another animal. Animals which have recovered from an attack of the disease are immune from a second attack. The cause of this disease has never been discovered, though many organisms have been isolated which were believed for a time to be the true etiological agent. Semmer attributes the disease to certain minute bodies, which he believes are usually contained within certain cell nuclei, and Nicolle and Adil Bey agree with Semmer to a certain degree. The two authors last named have made the most recent and apparently the most important contributions to our knowledge concerning the etiology of rinderpest. Certain lots of blood which they knew to be infectious failed to give any cultures, nor could the authors by the most careful microscopic examination find any bacteria or other microorganisms in the infec-

tious material. The next step, therefore, was to pass the diluted virus through filters of porcelain and of infusorial earth. Three grades of filters were used: (1) Thin-walled Berkefeld, yet thick enough to retain any of the ordinary bacteria; (2) the ordinary Berkefeld; and (3) the Chamberland filter (marked "F"). Using the thin-walled Berkefeld, they obtained filtrates which were sterile (in the ordinary sense), but which sometimes killed the cattle inoculated with them, sometimes produced an immunity without causing visible illness, or, again, they might be inactive. With the ordinary Berkefeld filters the results were the same, except that negative experiments were more frequent than in the first set. With the Chamberland F cylinder successful filtration is rare, death never being produced, and only occasionally the filtrate confers immunity upon the inoculated animal. From the experiments given in detail by Nicolle and Adil Bey there can be no doubt that the virus of rinderpest is filterable under certain conditions, and the failure of certain of their experiments is explained by the authors with the supposition that the virus is situated normally within the leucocytes. When a highly virulent filtrate is obtained they suppose that a sufficient number of the minute bodies which are probably the exciting cause in rinderpest have become detached from the cells in which they dwell, and are thus free to pass through the filter pores. In the instances where the filtrates had a protective action enough of the specific microorganisms were allowed to pass for the production of immunity, but not enough to bring on an attack of the disease. The work of Nicolle and Adil Bey has not yet been confirmed, but until it has been successfully contradicted we must be inclined to believe that rinderpest, the great cattle scourge, is caused by a microorganism too small to be demonstrated by the means now at our command.

RABIES.

The cause of this disease, which was investigated extensively by Pasteur himself and later by some of his most distinguished pupils, remains unknown to the present day. Pasteur expressed the opinion in 1882 that the virus of rabies is ultramicroscopic, but only within the last year has anything been done to substantiate this hypothesis. Remlinger and Riffat Bey in two communications to the Societé de Biologie in Paris record the passage of the virus of rabies through a Berkefeld filter marked "V." The passage through this cylinder was not constant. In one instance two out of nine rabbits inoculated with the filtrate, in another instance four out of ten, and in another two out of seven died of typical rabies, and in every instance where death resulted from the use of the filtrate it was possible to transmit the disease further to other rabbits. The filter which they used was

described as the most permeable Berkefeld. It was fine enough, however, to hold back the microorganism of chicken cholera which was used in all filtrations as a check. Other Berkefeld filters as well as the Chamberland did not allow the virus of rabies to pass through.

Schüder, in a note opposing the idea that the protozoan described by Negri may be the cause of rabies, announces that in experiments which he conducted the virus of rabies passed through a filter which was fine enough to withhold the spirillum of Asiatic cholera, and that he was able to reproduce the disease as well with the filtrate as with the unfiltered virus.

Celli and Blasi, by the use of a Buchner press, separated the fluid from the brains of rabid dogs and infected rabbits. The fluid obtained in this way was passed through the Berkefeld filters and the filtrate was capable of reproducing the disease. Of twenty-three inoculated rabbits only three survived, and of four dogs none survived.

Remlinger, in a very recent communication, reviews the previously quoted experiments by himself and Riffat Bey and reports other experiments confirming the earlier work. The statement is made that the virus of rabies will only traverse the most porous Berkefeld (V), the other grades (N and W), together with the Chamberland filters, never having allowed it to pass. It seems probable that this virus is about at the limit, in size, of filterable microorganisms, and that normally the virus may be within certain body cells, as Nicolle and Adil Bey believe to be the case with Rinderpest.

EPITHELIOMA CONTAGIOSUM.

Quite recently Marx and Stickler have described certain experiments with a disease of birds known as "epithelioma contagiosum," which are of the greatest interest because of the bearing they may have upon the malignant tumors of man, which present just now one of the most difficult problems that experimental medicine has to deal with. This disease, known also in Germany as "Geflügelpocke," is a skin disease of chickens, geese, pigeons, and other fowls. It affects the unfeathered portions of the skin, and is very contagious.

When transmitting the disease experimentally the authors usually chose the comb or gill flaps as the point of inoculation. After scarification they were rubbed with tumor masses from diseased chickens, the disease being transmitted equally well whether the virus was taken from very recent nodules or from the scabs on fowls in the third week of the disease. The filtration experiments of Marx and Stickler were conducted as follows: The tumor masses were ground up fine in a mortar with physiological salt solution, and then one portion passed through a Berkefeld and one through a porcelain filter (variety not stated). When the filtrates were found to be free of bacteria the scarified

combs of the chickens were rubbed with them. It was found that the virus passed through the Berkefeld, but was retained by the porcelain filter. This epithelial disease must, in the opinion of Marx and Stickler, be classed among those which are caused by a filterable virus. What was apparently this same disease in pigeons could be communicated to chickens, but the chicken disease was not infectious for pigeons. By these experiments the highly specialized nature of some of these epithelial diseases is well brought out, and failures to transmit the sarcomata or carcinomata of man to the lower animals can hardly be of much value in proving the infectiousness or lack of infectiousness of those malignant tumors for man.

OTHER INFECTIOUS DISEASES.

In addition to the diseases which have been reviewed more or less in detail in the previous portion of this paper, there are several others of minor importance which it seems should be classed among those caused by a filterable virus.

The mosaic disease of tobacco is considered by Beijerinck to be due to a living fluid contagium (*Contagium vivum fluidum*). There seems to be some doubt, however, as to the nature of this disease, some considering it merely a physiological disturbance and not at all infectious in the true sense.

The myxomatous disease of rabbits, described by Sanarelli, probably belongs in the same class with those just described. Many have suggested that smallpox and vaccinia are due to an ultramicroscopic organism, but up to the present time this view is unsupported by experimental evidence.

Throughout this paper the terms "ultramicroscopic" and "invisible" have been frequently used. "Invisible" is certainly applicable to all of these viruses except that of pleuro-pneumonia. This invisibility may depend upon any one of several causes: (1) It may depend upon the ultramicroscopic size of the objects in question; or (2) upon the fact that they can not be successfully stained by any of our present methods, and that unstained do not interfere with the rays of light to a sufficient degree to make their outline discernible; or (3) the virus may have no form, but may be in solution, as suggested by Beijerinck. The last hypothesis seems to be excluded by the evidence quoted in the preceding pages to the effect that some viruses pass through the Berkefeld filter but are retained by the finer-pored Chamberland, and, in addition, the adoption of a theory of this kind involves the acceptance of principles entirely at variance with our common ideas concerning the lower forms of life, although the phenomena in question can be explained by and made to harmonize with our present and long-established understanding that a cell is the lowest form of life that can exist. The second hypothesis can not be disposed of so easily. There

is some evidence to show that certain bacteria—quite small, it is true, yet large enough to be seen with our ordinary microscopes—do pass through some of our so-called bacteria-proof filters. Their passage through these filters may be explained by their peculiar consistency which enables them to pass the pores that offer a complete barrier to some equally small but less plastic organisms.

Wherry described a number of filtration experiments with the bacillus of guinea-pig pneumonia, using Berkefeld cylinders No. 5 and No. 8, and the Chamberland cylinder F. His first experiment was with Berkefeld No. 5, a vacuum of about 660 mm. being used. The filtrate was collected in five lots of about 25 c. c. each and placed in an incubator; only the two last portions collected showed growth. A second experiment carried out in the same manner resulted similarly, the only difference being that the last one only of the five lots collected showed growth. The organism did not pass through the large Berkefeld No. 8 nor through the Chamberland F filters.

Wherry states that the bacillus of guinea-pig pneumonia is 0.5 μ wide and 0.7 μ long. This is the only record of a microorganism whose smallest diameter is not less than 0.5 μ having passed regularly through Berkefeld filters.

Von Esmarch, in the course of his endeavors to ascertain the existence of ultramicroscopic saprophytes, isolated a very minute vibrio, which he named *Spirillum parvum*. This organism, from 1 to 3 μ long and 0.1 to 0.3 μ wide, passed through Berkefeld, Chamberland F, and other filters. Neither Wherry nor von Esmarch mentions the very important matter of the time required for their filtrations, and von Esmarch fails, in addition, to note the degree of vacuum which he employed.

Borrel, in the course of certain filtration experiments with the virus of sheep pox, found that very minute water vibrios passed through certain bougies. He also found a minute protozoan 3 to 4 μ long and 0.25 μ broad. This organism was named *Micromonas mesnili*, and is said to be the smallest known protozoan. Borrel, however, used filters especially prepared and very much more porous than the Chamberland F, as has been previously explained. All of the organisms which pass these filters, however, are unusually small and actively motile. The size, consistency, and motility evidently all play a considerable part in determining the filterability or nonfilterability of microorganisms.

By a series of ingenious calculations, Errera has endeavored to determine the limit in size of microorganisms. To use his own query, May there not be microorganisms as much smaller than ordinary bacteria as the ordinary bacteria are smaller than our largest trees? Errera's calculations, based upon the "atomic theory" and the weight of molecules, lead him to believe that it is impossible for living forms

to exist which are less than one-fifth or one-tenth the size of *Micrococcus progrediens*. This micrococcus is the smallest known, measuring only 0.15 μ in diameter.

Abbé and Czapski state that microscopes as they are now constructed will not permit us to distinguish objects smaller than 0.1μ, the difficulty lying in the illumination of the field rather than in the magnifying power of the lenses.

Siedentopf and Zsigmondy have recently devised a new microscope which they claim has enabled them to distinguish particles which are completely invisible when the highest magnification of the ordinary microscope is employed. The essential feature in this new microscope consists in the method of illuminating the field. A powerful oblique light is thrown upon the objects in such a way that they become visible, appearing as minute luminous points. It is to be hoped that Siedentopf and Zsigmondy have brought forth a principle in the construction of microscopes which may be utilized in bacteriological investigations.

The value of the researches herein described can not be overestimated. In addition to the light which they have thrown upon the etiology of certain infectious diseases, they have taught us that there are many disease-producing microorganisms which can pass readily through ordinary porcelain and earthen filters, and that one at least (that of horse sickness) is not withheld even by the finest-pored filter known. They have also taught us that clear fluids which yield no culture, by whatever method used, are not necessarily sterile, but may be very infectious and in the highest degree dangerous to men and animals. These discoveries indicate also that the fields of bacteriological research present unexampled opportunities for original investigations, and notwithstanding the great advances made during the last two decades there are yet greater things to come.

A better knowledge of the etiology of a disease always leads to more intelligent and therefore more successful efforts to combat it. On this account we have reason to hope that these filtration experiments will not only increase our knowledge of the causes of maladies which are now so baffling, but that they will also enable us to do more toward their prevention and cure.

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NEW FACTS CONCERNING THE ETIOLOGY OF HOG CHOLERA.[a]

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PRELIMINARY REMARKS.

During the course of the investigations concerning hog cholera which have been carried on by the Biochemic Division of the Bureau of Animal Industry, certain outbreaks of that disease were met with which apparently were not produced by the hog-cholera or the swine-plague bacilli. The disease was highly contagious and fatal to a large proportion of the hogs which were attacked. These observations, which were inexplicable previous to the researches herein recorded, together with the great variations in the physical symptoms and the postmortem lesions encountered in different outbreaks of so-called "hog cholera," have led us to institute experiments to determine, if possible, whether or not there are other infectious diseases among hogs in this country than those caused by the hog-cholera and swine-plague bacilli, and also to ascertain what was the etiological agent in those outbreaks of disease mentioned above, which apparently did not depend upon these bacilli for their existence. These experiments have not yet been completed, but have gone far enough to enable us to publish this preliminary information.

The outbreaks of disease which have furnished material for the study of the questions just outlined have all had their origin in southwestern Iowa, but, owing to the great distance of that point from Washington and the fact that it was not possible to establish a satisfactory laboratory in the field, it has been found necessary to expose a certain number of animals to infection in Iowa and then transport them by express to the Bureau Experiment Station near this city, where all the inoculations were made by the superintendent of the station. After once bringing the disease to Washington no trouble was, as a rule, experienced in perpetuating it by transferring from one animal to another.

The experiments have reached such a stage that we feel justified in stating that there is an infectious disease among hogs in this country which can not be distinguished clinically from hog cholera, and which may be reproduced by infecting with material which contains no hog-

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cholera bacilli. It will be understood that at this time no estimate can be made as to the frequency with which this disease occurs, nor as to its distribution throughout the country.

Below is presented a brief outline of the facts which have been established in regard to this disease.

ETIOLOGY.

Nothing can be stated at present as to the cause of this disease. It has been demonstrated, however, that the primary cause is neither the hog-cholera bacillus nor the swine-plague bacillus. We have transferred the disease repeatedly from one hog to another by subcutaneous inoculation of certain body fluids, these fluids being always proved, by careful bacteriological examinations, by filtration through the finest porcelain filters, and by the inoculation of guinea pigs and rabbits, to be free from hog-cholera and swine-plague bacilli. We have used a system of checks upon the various inoculation experiments by means of which we have been able to exclude all chance of accidental pen infection or of infection through the syringes.

The disease is highly contagious, healthy pigs that were allowed to come in contact with sick animals almost invariably becoming sick within the usual period of incubation. So far we have been unable to communicate this disease to any other animal than hogs. Rabbits and guinea pigs are entirely insusceptible to inoculations that are of sufficient size to destroy pigs weighing from 30 to 40 pounds.

SYMPTOMS.

The period of incubation after exposure to sick animals, or after a subcutaneous inoculation of infectious material from sick animals, varies from five to twelve days, the usual time elapsing between exposure and visible signs of illness being seven days. The first symptoms noticed are that the pig is slightly indisposed; there is loss of appetite and listlessness, but, as a rule, nothing else on the first day. By the second day of visible illness the animal is usually very sick, hollow in flanks, and has a staggering gait. There may or may not be diarrhea, and the feces are frequently blood-stained. Almost without exception the eyes are sore and the lids glued together. The symptoms just enumerated become gradually more pronounced until the death of the animal, which takes place, as a rule, within seven days after the appearance of the initial symptoms and approximately two weeks after the first exposure to infection.

It must be explained that the experimental pigs which we have used weighed from 15 to 40 pounds, and it is possible that in the case of older and larger animals the period of incubation and the course of the disease may be of longer duration. This point, together with many others, is left for future determination.

POSTMORTEM APPEARANCES.

The skin over the abdomen may be reddened throughout, or these cutaneous lesions may appear as more discrete purpuric areas of varying size. Upon removing the skin of the thorax and abdomen the subcutaneous areolar tissue is generally found to be thickly dotted with small ecchymoses. There is usually not the slightest evidence of inflammation at the point of inoculation if the animal has been injected subcutaneously.

LYMPHATIC SYSTEM.

The inguinal glands on both sides are reddened, as are the lumbar, retroperitoneal, mesocolic, mesenteric, and bronchial glands. The reddening of these glands varies in intensity; at times the hemorrhagic condition is slight, while at others it is so intense that practically all of the glands are deep red, approaching black in color.

DIGESTIVE SYSTEM.

(*a*) *Stomach.* There may be considerable congestion and inflammation of the mucosa and also small hemorrhages on the serous surface. (*b*) *The small intestines* usually present a large number of small ecchymoses on their serous surfaces and not infrequently the mucous surface is in the same condition. (*c*) *Cecum and colon.* This portion of the intestines, almost without exception, shows hemorrhagic areas on its serous and mucous surfaces, these hemorrhages being, as a rule, fewer in number and larger in extent than those seen in the small intestines. In the cecum and ascending colon it is not unusual to find large numbers of small newly formed ulcers which occasionally show a hemorrhagic center. (*d*) In several instances there has been a most severe hemorrhagic inflammation of the *rectum* extending throughout its entire length. The intestinal contents are not infrequently blood-stained. (*e*) *Liver.* This organ is usually mottled, and may exhibit diffuse grayish areas which appear to be due to an increase of connective tissue. Small ecchymoses and areas of necrosis are not infrequently seen on the surface of the organ. The histological examination of this organ has not been completed.

LUNGS.

The lungs frequently show hemorrhagic areas on their surface, but, as compared with the other organs, are usually slightly affected.

HEART.

Hemorrhagic areas are occasionally seen on the surface of the auricles and ventricles.

SPLEEN.

The spleen is always enlarged, dark in color, and not infrequently shows small petechiæ on its under surface.

KIDNEYS.

The kidneys are always the seat of hemorrhagic changes, which vary in extent. At times the whole organ is intensely congested, all the glomeruli being visible as minute, deep-red points, while at others it is as a whole not congested, but exhibits in its cortex a number of small, sharply defined, very dark hemorrhagic spots.

From the above-described lesions and symptoms it will be seen that this disease is apparently identical in all particulars with the acute type of hog cholera, and that it is produced without the aid of the hog-cholera bacillus.

The fact that this particular type of hemorrhagic hog cholera is so similar in both symptoms and lesions to the ordinary acute hog cholera supposed to be caused by the hog-cholera bacillus, and that, by our methods of inoculation, without the presence of the hog-cholera bacillus, we have never produced a case of *chronic* hog cholera, have led us to suspect that possibly in *all* outbreaks of *acute* hog cholera there is some other agent besides the hog-cholera bacillus at work, and that in those cases of acute disease where the hog-cholera bacillus is found we have to do, not with a pure infection, but with a mixed infection by hog-cholera bacilli and the organisms which are responsible for the disease which we have just described. In fact, virulent hog-cholera bacilli have been isolated from hogs in which the disease had been produced by inoculation with infective material in which the absence of the bacilli had been proved by filtration, by cultures, and by the inoculation of rabbits or guinea pigs.

If such supposition is well founded, it is quite evident what an important bearing it must have upon the prevention and treatment of hog cholera, and we hope to be able to decide this point positively when the experiments now under way shall have been completed.

Sufficient work has been done to show that this particular form of hog cholera may be prevented by those measures which have been found to be effective in dealing with the ordinary forms of that disease—the isolation of sick animals and disinfection of all infected lots with carbolic acid and lime being sufficient to prevent a spread of the disease.

METHODS OF PRODUCING IMMUNITY.

As experiments in this line and also in methods of producing immunity from this disease have been in progress for some years, it seems that, in view of the results, the important points of the investigations should be published, so that the State experiment stations and others, if they so desire, may make experiments on a large scale along the lines of work which have proved most successful.

On account of the often discordant results which were secured some years ago when the Bureau was treating diseased hogs with serum from

animals which in their turn had received large and repeated doses of hog-cholera and swine-plague cultures, it appeared that some other factor must be considered in the efforts to produce immunity. The first suggestion of de Schweinitz was that some parasite of the hog, such as the louse, should be studied. This was carefully done, but the results obtained were such as to make it appear that, while a louse might under certain conditions convey disease from a sick to a healthy animal, it was not the important agent in spreading so-called hog cholera.

A large number of specimens of blood from sick and healthy hogs were also examined and, while very small, peculiar, round bodies were found both inside and outside of the corpuscle, and sometimes bodies with distinct ameboid movement were noted, the relation, if any existed, of these bodies to the disease could not be determined satisfactorily. It was noted, however, that in cases of so-called hog cholera the disease could be readily conveyed from a sick animal to a healthy one by giving the latter a subcutaneous injection of the blood serum or defibrinated blood obtained from the former. It was found that a small fraction of a cubic centimeter would produce the disease, though we have in most of our experiments fixed 1 cubic centimeter as the most satisfactory dose for use. As has been indicated above, blood from a diseased animal which was passed through the finest Berkefeld or Chamberland filter produced in hogs the typical disease. This blood had been proved to be free from microorganisms detectable by the ordinary bacteriological methods or by the inoculation of small animals, such as the guinea pig or rabbit, which are known to be very susceptible to the ordinary hog-cholera bacillus. It appeared, therefore, that immunity could be produced by the use of blood in which the disease-producing property had been attenuated or partially neutralized. The experiments have well established the fact, which is also true of the so-called hog cholera, that animals once immunized against this disease will resist repeated large doses of disease-producing blood and also subsequent exposure to diseased hogs in the field.

The basis of the immunity experiments, therefore, has been the use of attenuated and disease-producing liquid or dried blood, or the use of this blood mixed with blood obtained from immune animals, in which animals the immunity has been increased by the injection of large doses of disease-producing blood obtained from hogs known to have the disease; or, in other words, disease-producing blood and antitoxic blood separate and combined have been successfully used.

In order to test the immunity of the treated animals, they were either exposed by inoculating them with known disease-producing blood or by placing them in the field or pen with sick animals.

The previous work of this Bureau has shown very clearly that animals immune from hog cholera are not necessarily immune from swine

plague, or vice versa, and, furthermore, that many different diseases may at times be mistaken for hog cholera. In making practical exposure tests, therefore, it is absolutely necessary to prove the character of the disease by careful autopsies and by the use of a large number of checks, which checks should succumb to the disease in order to prove the positive virulence of the exposure.

Although we are still trying the experiments on a large scale and shall continue them during the coming summer before recommending the details of a plan for practical adoption, we feel that these results of the extensive and laborious experiments which have been carried on by the Bureau for a number of years should be presented now in this concrete form, as it will require a number of months to prepare the detailed reports of the experiments for publication.

The writers have had charge of the general plan of this work and proposed the use of blood from diseased and immunized animals. The practical inoculations and autopsies at the Experiment Station of the Bureau have been carried out under the supervision of Dr. E. C. Schroeder, who also made, at the request of the Chief of the Bureau, some immunity experiments with dried diseased blood. The work in Iowa has been in charge of Dr. W. B. Niles.

INFECTIOUS AND CONTAGIOUS DISEASES OF FARM ANIMALS AND THEIR EFFECT ON AMERICAN AGRICULTURE.[a]

By D. E. Salmon, D. V. M.,
Chief of the Bureau of Animal Industry.

The subject which I have been asked to discuss at this congress is a very large one and includes so many different elements that it can only be treated in the most general manner in the short time at my disposal. The omission of many important details is therefore a matter of necessity rather than choice. What I shall hope to do is to impress upon you the necessity of controlling the contagious diseases of farm animals and the practical value to the farmers and to the country at large of the efforts of the Federal Government which are being put forth to investigate, to understand, and to control these diseases.

Animal husbandry is one of the most important branches of agriculture, and it has been developed in the United States to a degree which excites the admiration of the world and which justifies every legitimate effort for its assistance and protection. In no other country can you find such an aggregation of farm animals—animals in such amazing numbers, of such value, so highly bred, and so free from disease. Statisticians tell us that we have more than 19,000,000 horses and mules; over 17,000,000 milch cows; 44,500,000 other cattle; nearly 64,000,000 sheep; 47,000,000 hogs, and 250,000,000 fowls of various kinds. The horses and mules are worth $1,200,000,000; the cattle are worth $1,300,000,000; the sheep are worth $168,000,000; the hogs are worth $365,000,000; the fowls are worth about $86,000,000. In round numbers, the total value of these farm animals is $3,119,000,000. This, then, is the tremendous investment of capital which our farmers are holding in domesticated animals. It is generally regarded as simply representing so much wealth, and as a matter of interest to no one but the owners. But we must take a broader view than that of our animal husbandry. The cattle, sheep, hogs, and poultry are a large and essential part of the food supply of the nation, and the horses are necessary for the production of the other part of our food supply. Any cause which reduces the quantity of our food supply or increases the cost of its production makes the conditions of life, especially in the

[a] Read at the Farmers' National Congress, Niagara Falls, N. Y., September 23 1903.

large cities, more difficult, adds to the distress and misery of that part of the population which at best is merely able to exist, and tends to increase disease and mortality in proportion as its effects are felt. There are also times when through domestic disorder or foreign foes the very life of a nation is at stake, and in such emergencies the food supply has often been an important factor in its preservation. And one of the conditions which undoubtedly adds to the stability of our Government is the abundance and the high quality of our food supply produced by American farmers.

These considerations apply, of course, to all the elements of the food supply as well as to the domesticated animals, but they are of especial interest in connection with animals because of the imported plagues, which are generally preventable, but which often sweep a continent as with fire, depleting the supply of animal food, endangering the public health, and ruining many people who are engaged in agricultural pursuits. A calamity of this kind affects nearly the whole population of a country, depresses business, causes restrictions upon traffic, and often leads to the closing of foreign markets for the animals and animal products of the affected country.

The losses from communicable animal diseases in the United States, considering the large numbers of animals produced, have been moderate as compared with those of other countries, the distance from the Old World having for the most part protected us from the plagues which are most destructive there. Still we have had troubles of our own, and some of them very serious ones, and it is to the consideration of these that most of my time is devoted.

THE CONTAGIOUS PLEURO-PNEUMONIA OF CATTLE.

An imported disease known as the contagious pleuro-pneumonia of cattle led to the establishment of the United States Bureau of Animal Industry and to the active interest which the Federal Government has since shown in the protection of our farm animals from the ravages of communicable diseases. This plague was allowed to slumber in the eastern part of the country for forty years before active measures were inaugurated by the General Government for its suppression. Fortunately the current of traffic was from the West to the East, or the contagion would have been spread beyond the possibility of eradication. Nevertheless, diseased cattle were taken to the West, and the plague appeared in Ohio, Illinois, Missouri, and Kentucky, threatening the entire cattle industry of the country. In this precarious and dangerous situation, when the integrity and the prosperity of the cattle industry for many years in the future, if not for all time, hung in the balance, we had divided counsels. Men who had never seen the disease, for the good reason that they had never looked for it in the places where it prevailed, insisted that it did not exist upon the Ameri-

can continent; others urged impracticable plans for its eradication, and there were not wanting those who claimed that the effort for the control of the disease was simply a raid on the Treasury, and that the disease would last as long as appropriations were made.

Under these apparently discouraging conditions an inadequate appropriation was made, with no direct authority to go into the States where the disease existed and enforce the measures necessary to combat it. However, the best that could be done under the circumstances was done; the contagion was held in check, and evidence of its existence was produced. To be brief, the funds were soon increased, more power was given, and within five years from the beginning of the work the contagion was totally stamped out; and although a dozen years have since gone by the disease has not again been found on this continent. There still remains, however, an unpleasant reminder of the fact that it once existed here. In 1879 the British Government, on the ground of the existence of this disease in the United States, prohibited our exported animals from going inland to market and required them to be killed on the docks where landed. That regulation is still in force, and with the oft-demonstrated disinclination of the British officials to treat our cattle trade with justice (we have never asked for generosity) it would appear that there is little likelihood of its being removed, at least during the lifetime of the present generation. The effect of this regulation is not as injurious to-day as it was a quarter of a century ago, when first instituted. Then it depreciated our cattle from $5 to $10 a head, but the trade has since adjusted itself to the existing conditions, and now the loss on this account is comparatively light.

The results which followed this pleuro-pneumonia work were of incalculable benefit to the agriculture of the United States. In the first place the celerity with which the disease was eradicated here was an object lesson to the whole world. Great Britain, Germany, France, and other European countries had for many years been enforcing measures in a half-hearted manner for its suppression without success, and for a long time they were incredulous that we had succeeded. An abundance of time has now elapsed for a complete demonstration, and this has given our Government a reputation for intelligence and efficiency in the control of animal diseases which has been of considerable assistance in preventing restrictions and prohibitions from being placed upon our animals and animal products in various parts of the world. Great Britain has also followed our example and stamped out the disease, thus relieving us of the menace of its reintroduction with British cattle.

The most important result of the pleuro-pneumonia work, however, was probably the establishment of a bureau in the national Department of Agriculture to investigate and furnish information concerning

the animal industry of the country and to perform such executive work in relation to animals and animal products as may from time to time be necessary or desirable. The inspection of meats for interstate and foreign commerce was inaugurated immediately after the termination of the pleuro-pneumonia work, and this, together with the scientific investigation of disease, enabled us to collect and maintain a force of trained experts who were available for immediate service in an emergency such as we have had in New England during the past year.

The eradication of pleuro-pneumonia has also been an object lesson of the greatest value for our own farmers. It has proved to them that, notwithstanding our peculiar form of government and the rights of the sovereign States, it is possible for the Federal Government to eradicate animal diseases in this country. It has also proved that certain plagues of animals are of exclusively exotic origin, and that if the contagion is once thoroughly stamped out those diseases will not again be seen until fresh contagion is introduced from abroad. This is a lesson which we all need to have forced upon us again and again before we can appreciate the great importance and the permanent value of prompt and efficient work in stamping out such plagues. It is not difficult for anyone to understand that if all the zebras, for example, on the American continent were killed off there would never be any more here until there had been another importation of these animals; but when it concerns the infinitely small forms of life which constitute the contagion of the animal plagues it requires actual experience with them before we can fully realize that the same principle holds good with them as with the larger species of animal and vegetable life.

FOOT-AND-MOUTH DISEASE.

Late in November of last year the country was astounded to learn that an extensive outbreak of foot-and-mouth disease existed in the New England States. We had for years maintained a rigid quarantine of all susceptible animals coming from countries where the disease existed; we had taken special precautions to insure, so far as possible, the disinfection of hides from infected countries; we had held up, inspected, and in some cases quarantined menagerie animals; we had been particularly careful to prohibit or disinfect halters, feed bags, hay, and bedding that came with animals from infected countries. The entrance of the contagion was therefore a mystery, and one which has not yet been satisfactorily cleared up. What we know is that the disease was first seen near the docks and spread from there toward the interior. There are, of course, many ways in which the contagion might be brought and escape our inspectors, but it does not often come through such channels, as is proved by the fact that this is the first outbreak of the disease that we have had in twenty years, and the only

one that we have ever had that could not be traced to the importation of diseased cattle.

When I arrived in Boston, December 1, more than one hundred herds of diseased cattle had already been discovered in Massachusetts, Rhode Island, and Vermont. The local quarantine was largely disregarded, and people going from one stable to another carried the contagion and extended the infected area. Cattle dealers were gathering up animals in the infected sections and shipping them to market; in some cases they sent them to other States. Cars were thus infected, with imminent danger of their carrying the disease to the interior of the country. Newly diseased herds were reported daily. In this emergency it was necessary to stop the exportation of cattle and sheep from Boston; it was also necessary to quarantine the States in which the disease existed, and to prevent cattle, sheep, hogs, and undisinfected railroad cars from going to other States. After duly considering the practical impossibility of maintaining an efficient quarantine of the diseased herds and the failure of other countries which had endeavored to control such outbreaks by quarantine, it was decided to kill at once all susceptible animals upon the premises where the disease was found.

This plan was carried out, and the only exceptions made were in the case of herds which had gone through the disease and entirely recovered before they could be reached. Before the work had progressed very far it was found that the disease also existed in New Hampshire and had been quite extensively disseminated in that State. The same regulations were applied there as in the other infected States. As soon as possible after the herds were killed, the barns, stables, and yards were disinfected by trained men and at Government expense. In some cases the hay, straw, and other fodder were purchased and burned. As a result of this thorough work the disease was stamped out, and no new territory was infected after the Government force was organized and put into the field.

The measures adopted to suppress this outbreak were looked upon by some citizens as extremely arbitrary and harsh, and the Department of Agriculture has even been censured for securing the prosecution and conviction of men who deliberately violated the quarantine and drove cattle out of the infected States for the purpose of shipping them to the general markets of the country. But suppose the disease had been spread in this manner and new outbreaks had appeared in other States, would not the Department have been even more severely censured for failing to control the contagion? There appears to be a tendency to look upon laws and regulations as things which are made to be violated, and if this tendency were encouraged it would be impossible to stamp out such plagues as foot-and-mouth disease. Undoubtedly the best policy is to make only such regulations as are absolutely

required, to keep these in effect only for the time that is necessary, and to enforce them with the utmost rigidity. This policy hastens the progress of the work, it lessens the burden of the great mass of citizens, and it gives a greater assurance of success. In carrying out this policy in New England the Department had the support of a majority of the people, and especially of the farmers, although there was much opposition in a few of the badly infected localities. The cooperation of the State government was secured in every case, and was of inestimable value in hastening the operations and in securing success.

Foot-and-mouth disease is said to cause more loss in Europe than do all the other animal plagues combined, and yet there is generally so small a proportion of deaths from it that it is sometimes hard to convince the owners of affected cattle of its serious nature. Different outbreaks show great variations in virulence, and in the same outbreak the disease may be severe in one locality and mild in another. Practically all cattle, old and young, sooner or later contract the disease, and the sheep, hogs, and poultry may also be affected. Averaging up the losses, we may assume that about 5 per cent of the cattle die, the remainder, through loss of flesh, loss of milk, abscesses in the udders, and lameness, shrink 25 per cent in value. Many of the calves are lost. Sheep and hogs are stunted in growth, lose flesh, and many of the young die either directly from the disease or from complications which follow it. Sheep on ranges, where the losses from inclement weather are always considerable, are so weakened by foot-and-mouth disease that the winter losses are greatly increased.

Taking all the facts which have been mentioned into consideration, we may conclude that the extension of foot-and-mouth disease over the United States would, in the course of three or four years, cause our farmers a direct loss of about $400,000,000. However, we have no assurance that the disease would disappear at the end of that time. On the contrary, the contagion might persist here, as it has in Europe during the last outbreak, for fifteen or twenty years, causing continual loss and stunting of the young stock, shrinkage of flesh in all classes of animals, with especially severe loss and interruption to the dairy business. The loss during this period of recurrence might be conservatively placed at $50,000,000 a year. The total loss to our farmers from such an outbreak would, therefore, be not far from $1,000,000,000 for twenty years. But there are other losses which must also be considered. We saw last winter how soon Great Britain prohibited the importation of animals from the New England ports. This affected only the transportation companies and the ports directly concerned, but if we had a general outbreak of the disease animals from all our ports would be prohibited. The foreign market would be destroyed, the price of animals would be unfavorably affected, and there would be inconvenient and burdensome restrictions upon traffic

in every State. This would be a most serious calamity, and one which should be averted at any reasonable cost.

RINDERPEST.

The rinderpest, or cattle plague, of Asia and Europe has never appeared on American soil, but it is liable to be brought here at any time, and we must be on our guard against it. This disease spreads as easily as foot-and-mouth disease, and it kills within a few days 90 to 95 per cent of the cattle. Recently methods of vaccination have been practiced by which the loss may be reduced to about 30 per cent. Under the best conditions, however, it is a disease to be feared and avoided by every means in our power.

The increase in transportation facilities and the greater speed of steamships increase the chances of the introduction of such diseases into our country. Every day that is cut off of the voyage between the Old World and the New brings the source of these diseases one day nearer to the United States and makes greater precautions necessary. With foot-and-mouth disease in Europe and South America, and with rinderpest in the Philippines, in South Africa, in Egypt, and in Asia, we have to face danger in many directions. We can not in this age of the world adopt a policy of absolute nonintercourse with other countries, and consequently we must incur some danger of meeting with one of these terrible calamities which bring financial loss almost equal to that of a great war.

INDIGENOUS DISEASES.

We have so far discussed exotic forms of diseases—those which are not domiciled among us, and which must be fought by exclusion or by the most rigid stamping-out process whenever they enter our domain. In addition to these, we have diseases which, whatever their original source may have been, are now widely disseminated, and must be looked upon as indigenous. Such diseases require different treatment from the exotic plagues. It may without doubt be good policy to kill off all the affected animals in a restricted area to prevent the spread of contagion to other parts of the country; but if the contagion has already been scattered to all sections of the country, this measure is obviously impossible and other means of control must be devised. The character of such measures will depend somewhat upon the nature of the individual disease to be controlled and upon other existing conditions.

TEXAS CATTLE FEVER.

We have in the United States a disease of cattle which at one time was regarded as most mysterious, but which is now as well understood, owing to the investigations of the Bureau of Animal Industry, as is

any of the diseases to which reference has been made. This disease, which we know as Texas fever, exists in various parts of the world, but was first described, so far as I am aware, in the United States something over a hundred years ago. The great peculiarity of this disease is that it affects nearly all of the cattle in a large area of the southern part of the United States. These cattle apparently do not suffer from it, but if they are brought out of the infected section they spread the disease in a fatal form among other cattle; and if cattle from the noninfected part of the country are taken to the infected section they contract the disease, and, if adult, they die in the proportion of 70 to 90 per cent. This disease has had a tremendous influence on the agriculture of the South Atlantic and Gulf States. In the first place it has made the improvement of the native stock of cattle a very difficult and expensive operation, because nearly all of the purebred animals taken there for that purpose die within a year of Texas fever. In the second place it has limited the market and reduced the price of the cattle produced in that section, because the great markets of the country are in the noninfected section, and it is necessary to handle these Southern cattle in such a way that they will not disseminate disease among Northern cattle.

Under such discouraging conditions it is not surprising that we find the cattle industry in a rather backward condition in most of the Southern States. Many people there have shown much enterprise, however, in building up herds of good cattle, notwithstanding the losses which they suffered. A large part of the Texas cattle have been bred up to a high degree of excellence as beef-producing animals, and many herds of good cattle are also to be found in the other Gulf States. There was a time, not so many years ago, when Texas fever threatened the prosperity of the cattle industry in our Northern States. Thousands of Southern cattle were brought North for feeding and were sold for slaughter in all of our stock yards. There was no way to discriminate between those which were infectious and those which were not. Cattle cars and stock yards were infected and the disease was spread everywhere. It was unsafe to buy any cattle in the general markets of the country except for immediate slaughter.

The Bureau of Animal Industry, by its investigations and its inspection service, has greatly changed all of this. We now know exactly the section of country from which the infected cattle come. We also know that the disease is spread by the Southern cattle ticks, and that if the cattle are free from these ticks they are not dangerous. The infectious cattle are not allowed to be sold for grazing outside of the infected district except during the cold months when the tick can not develop; but such cattle are sent to market for slaughter at all seasons of the year as quarantined animals. They go in cars which are plainly marked "Southern cattle," and they are unloaded only in yards which

are maintained for that class of animals. In this way a market is kept open for the Southern States without endangering the cattle industry of the North. Deaths from Texas fever developing in cattle are now comparatively few, and their influence on the cattle industry is insignificant.

We have, however, accomplished more than this. We have shown that Texas fever is caused by a microscopic animal parasite which lives in the red corpuscles of the blood, and that this parasite lives in two hosts—the bovine animal and the tick. Following up this clew it was found that several diseases of mankind—notably malaria and yellow fever—are likewise caused by parasites having two hosts, and this knowledge has led to a complete revolution in the measures adopted for the prevention of these diseases. But this line of thought is carrying us away from our subject; nevertheless, something practical for agriculture as well as for medicine has come out of this knowledge. It was shown that the parasite of Texas fever once introduced into the blood of an animal remained there in an active condition during that animal's life, and that the blood of Southern animals might be used successfully to inoculate purebred cattle and render them immune before they were taken to the infected district. This must, of course, be done under certain favorable conditions, but it is a great step in advance, and it enables the stockmen of the South to improve their cattle at much less expense than heretofore.

We have endeavored for years to discover some inexpensive means of destroying the ticks upon the Southern cattle without injury to the cattle themselves, but the solution of this problem has been most difficult and evasive. If all of the ticks upon the cattle could, with certainty, be killed, the animals could then go anywhere without restrictions or danger, and the infected district could be rapidly reduced in size. This would have a very beneficial effect upon the agriculture of that section of the country. Whether we will eventually succeed in this can not be foretold, but success has been very nearly reached on several occasions, and recent experiments have been encouraging.

TUBERCULOSIS.

The disease which is now especially deserving of attention in this country is tuberculosis. It affects all species of animals, but is particularly common with cattle and hogs. It is also the most common and fatal disease of mankind. Its continued prevalence and increase must have a serious effect upon American agriculture by diminishing the vigor and productive capacity of our cattle, by destroying valuable breeding animals and blotting out valuable strains of blood, by causing the destruction of many carcasses of beef and pork because unfit for food, and by damaging the reputation of our meat and dairy products. While we are perhaps better off with reference to tuberculosis

than are most other countries, we nevertheless have far too much of it, and as it causes losses greater than those of most other diseases there is every reason why we should adopt measures for lessening its spread and for diminishing its frequency.

Tuberculosis has been brought to this country and spread among our live stock very largely through imported purebred stock which was designed to improve the herds and increase the profits of agriculture. It is allowed to remain and propagate itself almost without hindrance in nearly all of our States, because our farmers do not understand its nature and fail to appreciate the damage which it causes.

The time has already arrived when it is extremely difficult to establish a breeding herd representing any one of several of our most popular breeds of cattle without introducing this disease; and the common cattle are becoming involved to such an extent that a dairyman can hardly buy cows in the open market to replenish his herd without getting those which are affected with this disease. Of course, the breeders and dairymen do not advertise the fact that their herds are diseased, and consequently we hear very little of their disappointments and their losses. It is, as a rule, only public institutions which have endeavored to establish herds and which can afford to tell of all that they have suffered from tuberculosis. It may be instructive to recall a few such herds to illustrate the importance of this subject: Soldiers' Home, Washington, D. C., 63 animals—53 head, or 84 per cent, tuberculous; Massachusetts Agricultural College, 32 animals—25 head, or 78 per cent, tuberculous; New Jersey Agricultural Experiment Station, 42 animals—25 head, or 60 per cent, tuberculous; Vermont Agricultural Experiment Station, 33 animals—21 head, or 64 per cent, tuberculous; Ohio Agricultural Experiment Station, 30 animals—14 head, or 46 per cent, tuberculous; Texas Agricultural Experiment Station, 21 animals—10 head, or 48 per cent, tuberculous; Wisconsin Agricultural Experiment Station, 30 animals—26 head, or 86 per cent, tuberculous; Kansas Agricultural College, 56 animals—15 head, or 27 per cent, tuberculous; Government Hospital for the Insane, Washington, D. C., 102 animals—79 head, or 77 per cent, tuberculous; Maine Agricultural Experiment Station, herd so badly diseased that all the animals were slaughtered. This list could be increased to almost any length desired, but surely it is sufficient for my purpose. If these institutions, with expert assistance and using public funds, could not keep their herds free from disease, how is the young breeder or the busy dairyman to succeed? It will be noticed that the herds mentioned were in widely separated parts of the country, and this experience shows, therefore, that the difficulty is not confined to any one section or to any set of climatic conditions.

In a letter to one of our agricultural journals Prof. W. A. Henry,

director of the Wisconsin Agricultural Experiment Station, gave the following statement of experience:

> Several years ago the writer of this communication received a letter from a good citizen in the State of Iowa, asking him to name some breeder of good cattle of a certain breed from whom the inquirer might purchase some choice stock. As a result this Iowa party came to Wisconsin and purchased 7 head of purebred stock, paying good prices for them. In taking that stock back to Iowa he carried back tuberculosis in the most virulent form it ever affected a herd in this State. He lost all of the 7 animals purchased through death by tuberculosis, and contaminated his whole herd so that he was forced to sacrifice all of the dairy animals he had. And this is but one of more than a dozen places where tuberculosis was spread by sales from a single herd of purebred cattle.

This observation made by Professor Henry is an illustration of what is going on continually in all parts of the country. I recently saw a cow which an enterprising and enthusiastic breeder had paid a large price for—several thousand dollars, by the way—because he wanted that particular strain of blood; and I was told on good authority that when she reached her new home she was found to be affected with tuberculosis. Now, how can a man afford to put his money into good cattle and endeavor to build up a valuable herd with such danger—I might almost say with such certainty—of its being sooner or later infected with this insidious and destructive contagion? The fact is, there are comparatively few men trying to breed purebred animals free from tuberculosis, and the fountain head to which our farmers have been taught to go for improved blood is a source of deterioration and disease.

This may be strong language, but it represents the actual condition of affairs, and unless something is done soon to remedy it the development of our cattle industry will receive a check from which it will not recover for years. The integrity of our meat supply as well as of our dairy products is threatened. It has been our proud assertion for years that we had the healthiest animals and produced meat the freest from disease of any in the world. Are we going to allow ourselves to drift into the same distressing condition in this respect that is seen in European countries? The Federal meat-inspection statistics, which cover 5,000,000 to 6,000,000 cattle and 25,000,000 hogs a year, show that the condemnations on account of tuberculosis are increasing from year to year at a rate that must cause anxiety to every one interested in American agriculture.

In an effort to attract the attention of our people to this important subject, and to stem the tide of tuberculous animals that has been pouring into this country from abroad, the Department of Agriculture has prohibited such diseased animals and provided that all imported cattle should be tested. The testing of these cattle offered for importation has proved that many of the foreign herds are so diseased that they are absolutely unfit to furnish breeding animals, and

this notwithstanding the fact that there has been much trickery on the part of the breeders and dosing with tuberculin and other drugs to prevent a successful test.

What is needed is an effort all along the line to prevent the importation of diseased cattle and to eradicate tuberculosis from our own herds. Above all, it is important that our purebred herds should be put into a condition to supply animals that are healthy and that will improve the common herds into which they are taken.

There has been much said during the last three or four years concerning the relation between human and bovine tuberculosis. While, as I have shown, the effect of this disease upon the animal industry is so disastrous that it should be suppressed for economic reasons alone, its danger to human health is another and equally strong reason why such action should be taken. It is only two years since a great authority on tuberculosis proclaimed in the London Congress on Tuberculosis that the tuberculosis of man could not be transferred to cattle and that the tuberculosis of cattle was not transmissible to man. That doctrine is already discredited and absolutely disproved by the experiments of many investigators. Indeed, the very commission which was appointed by the German government at the request of Koch, and which has shown its bias in his favor, has made a report which demonstrates not only that human tuberculosis may be communicated to cattle, but that by their most conclusive test 25 per cent of the tuberculosis of children which they investigated was of bovine origin. It is unnecessary to dwell upon this fact. The farmer's family should be protected from tuberculosis no less than his cattle.

SCABIES OF SHEEP.

The scabies, or scab, of sheep is a disease which has been an incubus upon the sheep industry for many years. It has prevented the infected flocks from thriving; it has caused a great loss of wool; it has weakened the animals so that they were unable to withstand the cold, exposure, and other hardships of winter, and it has checked and discouraged the development of the industry. It has been particularly severe on the Western ranges, and the marketing of diseased animals thoroughly infected the sheep cars and stock yards. In order to control this disease, the Department has prohibited the shipment of diseased animals from one State to another, and is cooperating with a number of States for the suppression of the pest. There is no disease which may be cured more easily, more certainly, or with less expense, and the result of the work has been to lessen greatly the prevalence of the disease. To make this improvement permanent, we are taking groups of States, as many as can be handled at a time, and are stamping out the disease in the whole section. We expect in this way to clean up the sheep-raising country and in the course of a few years to

eradicate the disease entirely. This will greatly increase the profits of sheep husbandry and make it a more certain and stable business.

HOG CHOLERA.

The one disease of farm-animals which has gone on unchecked, and which has baffled us in our efforts to develop a plan of campaign that would seem to promise success, is hog cholera. The average loss from this disease is probably not less than $50,000,000 a year. It ruins many farmers, and it makes the production of our pork cost more than it ought. But, nevertheless, we have an abundance of pork, and the losses from the disease are accepted as one of those inevitable things which can not be escaped. The time is coming, however, when, with the increase of population and the limiting of the corn-producing area, it will be a great object to save the hogs which now die from this cause. Indeed, this $50,000,000 would be, even at the present, a most welcome addition to the farmers' income.

I have not time to say more relative to this subject than that we have never given up the hope of finding a means by which this disease may be successfully controlled. The scientific investigations have been continued and discoveries have recently been made which explain some of our past failures and offer some encouragement to expect better results in the future. This disease is one of the most difficult, from a scientific point of view, that has been investigated, and much time is required to establish facts concerning its nature, even when the method of research that should be used has been made clear.

BLACKLEG.

A disease of cattle prevails in many sections of the country which is known as blackleg, or symptomatic anthrax. In some districts it has destroyed from 10 to 20 per cent of the young cattle, and almost prevented the production of bovine animals. Some years ago the Department introduced a vaccine for this plague which has been so successful as to reduce the losses to about one-half of 1 per cent. More than 1,688,000 doses of this vaccine were distributed last year, and we have reason to believe that nearly all of this was used. There is here a very large saving which has been brought about by scientific investigation and by the intelligent application of proper methods of prevention.

There are a number of other contagious diseases of animals, such as glanders, anthrax, and rabies, which have considerable influence upon agriculture, but which I shall not discuss at this time. What I wish to impress upon you is that, as the number of animals in a country increases, as the transportation facilities improve, as the traffic in live stock becomes more brisk, the danger from communicable diseases increases and the necessity for official control becomes more urgent.

To control such diseases in a great country like the United States is an undertaking of such magnitude that it must have the earnest and cordial support of the farmers to insure success.

There are a number of ways in which the communicable diseases of farm animals affect agriculture, and in order that these may be clearly placed before you I have recapitulated them as follows:

(1) By the direct loss of the affected animals.

(2) By loss of business on account of an outbreak of disease, as usually occurs when dairies are affected.

(3) By the expense of treating the animals and disinfecting the premises.

(4) By quarantines and other restrictions.

(5) By the reduction of value of individual and product in the case of animals which live.

(6) By the destruction of valuable breeding animals and by checking the improvement of breeds.

(7) By the loss of markets which are closed to countries in which certain diseases exist.

FACTS CONCERNING THE HISTORY, COMMERCE, AND MANUFACTURE OF BUTTER.

By Harry Hayward, M. S.,
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THE USES OF BUTTER IN ANCIENT TIMES.

Butter is one of the oldest of all the articles of present diet. We learn from the Vedas, written 2000 to 1400 B. C., that the Hindoos were interested in cattle raising, that they valued their cows according to their yield of butter, and that they used butter as food. The quality of the article as then made is very uncertain. From the Greek derivation of the word, which means cow cheese, it may be inferred that it contained nearly as much casein as fat, and was, perhaps, hardly entitled to the name of butter, as the article is now known.

From "Kirne and Kerbe," Martiny's work, we gather that a number of foreign countries, which at the present time have little or no dairy interests, were among the first to make some use of butter. Among the peoples who used butter before the Christian era may be mentioned the Scythians, to whom it was known as early as 450 B. C., and the Greeks, who used it about the same time. A little later than this the Persians made butter, and Strabo states that about 60 years B. C. it was used by the Portuguese.

In early times butter was employed in many ways. The Hindoos used it for the greatest and holiest sacrifices in their worship. The Greeks and Romans did not use butter as a food, but as the standard remedy for injuries to the skin. The soot of burned butter was regarded as a specific for sore eyes. The Romans also used it as an ointment to enrich the skin and as a dressing for the hair. In the time of Alexander I certain of the Macedonians anointed themselves with milk oil; and Galen records that in many cold regions people used butter in the bath. Historians speak of butter used as a remedy for wounded elephants, and within a century butter was used in large quantities in Scotland and North England for smearing sheep, also as oil for lamps. Besides being applied externally, it was used internally for various troubles. In Spain as late as the seventeenth century butter was to be found in the medicine shops for external use only. In the middle of the previous century "A medicinal and economic treatment of butter" sets forth in detail the value and use

of butter as a remedy. In rural districts in Germany at the present time fresh, unsalted butter is much used as a cooling salve for burns.

Aside from its use as food, a cosmetic, and medicine, the use or possession of butter was long regarded as indicating wealth, and so served to distinguish the rich from the common people. Evidences of this still exist. In both Chilas and Darel a practice exists of storing up butter in the ground. Butter so stored is left a number of years, and, to insure its not being disturbed, a tree may be planted over it. Under these conditions it turns deep red and is highly prized. The owner's wealth is computed by the quantity of butter he has stored up in this manner.

Butter was enjoyed as a food by comparatively few people in its early history; those who did so use it seldom ate it fresh. The general practice was to melt it before storing away, and instead of being a spread it was employed to enrich cooked foods. Others, even in comparatively recent times, used the rancid stored butter as an appetizer. In Dardistan peasants are said to highly value salted butter grease that has been kept a long time, and that which is over one hundred years of age is greatly prized.

Little is known of the part which butter played as an article of commerce in ancient times. However, an early historian states that in the first centuries butter was shipped from India to ports of the Red Sea. In the twelfth century Scandinavian butter was an article of over-sea commerce. The Germans sent ships to Bergen, in Norway, and exchanged their cargoes of wine for butter and dried fish. It is interesting to note that the Scandinavian king considered this practice injurious to his people, and in 1186 compelled the Germans to withdraw their trade. Toward the end of the thirteenth century, among the enumerated wares of commerce imported from thirty-four countries into Belgium, Norway was the only one which included butter. In the fourteenth century butter formed an article of export from Sweden. It may be fairly inferred that butter-making in north and middle Europe, if not indeed in all Europe, was introduced from Scandinavia.

John Houghton, an Englishman, writing on dairying in 1695, speaks of the Irish as rotting their butter by burying it in bogs. His report was confirmed by the discovery, in 1817 and later, of butter thus buried, packed in firkins. This burying of butter in the peat bogs of Ireland may have been for the purpose of storing against a time of need, or to hide it from invaders, or to ripen it for the purpose of developing flavor in a manner similar to cheese ripening.

PRESENT STATUS OF THE BUTTER INDUSTRY.

The butter produced annually in the United States somewhat exceeds 1,500,000,000 pounds, and requires the milk from about 10,000,000 cows. These cows are kept on something like 4,000,000

farms, and furnish occupation, wholly or in part, for about 7,000,000 people, or nearly 10 per cent of the population. The total value of the annual output of butter is nearly $300,000,000, which is a little more than 5 per cent of all agricultural products of the United States. Considered as a crop, it is exceeded in valuation only by corn, wheat, hay and forage, and cotton.

Although butter is very generally used by all classes, it is an interesting fact that more than one-half of that produced in the United States is made in seven States and half the remainder in seven other States. The transportation in excellent condition of butter produced in large dairy centers to nonproducing States is made possible by a highly developed refrigerating-car system. By this it can be shipped, even during the hottest weather, without being subjected to high and detrimental temperatures.

The methods of conducting the butter industry have changed materially during the past twenty-five years. The greatest factor concerned in these changes was the introduction of the centrifugal cream separator, which did much in developing the creamery system. Other factors having a greater or less influence upon the development of the butter industry are those which have brought the principles of physics, chemistry, and bacteriology to bear upon its manufacture, thus taking the making of butter out of the realm of empirical arts and putting it upon a scientific basis. As a consequence, butter is not only made more economically but it is of finer quality, and the annual consumption per capita is consequently increasing. Before the dairy industry had attracted the attention of scientific investigators it was believed that it was impracticable to make good butter west of the Mississippi River. But owing to the general adoption of improved methods in what was at one time considered the far West, there is a large product of fine butter in the trans-Mississippi States. In one of these States (Kansas) is the largest creamery in the world, while Iowa leads all other States in total production. It may be said that the butter belt is now west of Indiana, while it was formerly east of Ohio. This change has been brought about partly by the increased demand upon the Eastern dairymen for milk, partly by cheap cattle food and cheap transportation rates from the West to the great Eastern markets, and partly by the settlement of the West by people from the dairy districts of continental Europe with whom butter making was an inherited art.

While the production of butter in the United States is about 1,500,000,000 pounds annually, 94 per cent or more is consumed at home, leaving but 6 per cent or less for export. The exported butter consists chiefly of the inferior grades, very little of the high quality going abroad

BUTTER AS A FOOD.

While the United States to-day perhaps leads all countries in the total production of butter, there are those which exceed it in the consumption per capita. This is due, probably, to the cheapness of meat in America compared with the prices in foreign countries. England consumes 30 pounds of butter per capita annually, while the people of this country eat but 20 pounds per capita. According to recently gathered statistics butter constitutes about 2 per cent of the total food and furnishes 19.7 per cent of the total fat in the average American diet. Butter is used by nearly all classes of society, and it has been found that in many cases working classes insist upon the best grades.

Besides being a food and furnishing a considerable source of energy, it may also be used as a special diet for some invalids. In cases of exhausting illness which has reduced the body or where quick growth needs extra nourishing, butter may be substituted for cod-liver oil. Since it is so easy to assimilate, large doses can be given with impunity. A quarter of a pound of good butter can be spread upon thin slices of bread and taken easily by nearly everyone needing this kind of concentrated nourishment.

HEALTHFULNESS OF BUTTER.

Butter is a food product concerning which there need be but little fear in regard to its carrying disease. As fat of any kind is a medium in which few bacteria can develop, butter is not considered a conveyer of disease to any such extent as milk. Furthermore, butter which is made in an uncleanly manner, or in insanitary surroundings, or from undesirable raw materials will usually make these facts manifest in one way or another by poor quality, usually accompanied by unpleasant odor and taste. Butter is such a sensitive product that its taste or smell quickly shows if it has been subjected to unwholesome surroundings.

PHYSICAL AND CHEMICAL QUALITIES OF BUTTER.

FLAVOR.

To the average consumer the flavor of butter is one of its most important attributes, and many highly esteemed judges pay little attention to anything but its flavor and aroma. As everyone knows, these differ greatly in the different butters. The principal factors in determining flavor and aroma, so far as known, are the development of various organisms of the lactic-acid forming group, the feed, and the period of lactation of the cow. In some cases, no doubt, the individuality of the cow also plays an important part. So widely have bacteria become recognized as of primary importance in develop-

ing butter flavor that many skillful makers depend upon this agency for producing flavor almost at will. In Denmark the practice is almost universal of pasteurizing the cream, and then using "starters," or cultures of organisms, favorable for the purpose. The cream is heated sufficiently to destroy most of its inherent bacteria, then cooled, and to it is added from 5 to 15 per cent of its weight of skim milk in which lactic-acid bacteria have been grown and allowed to develop until the cream contains about seven-tenths of 1 per cent of acid. The flavor developed by this process is mild and clean, and the butter keeps better than where no care is taken to destroy those ferments which are always inherently present in the cream and which tend to produce undesirable flavors.

The chief reason why butter made in the early summer is better flavored than that made at other seasons of the year is that the proportion of undesirable ferments to the acid-forming bacteria is smaller than during the cooler and winter months. As already stated, cream is not usually churned until the bacteria have developed from five-tenths to seven-tenths of 1 per cent of acid. If this amount of acid is not developed the butter will lack flavor and character, while if more than this amount of acid is developed the butter will be sour and have an undesirable flavor. It is an interesting fact that no other way of developing acid in cream will produce the desired result. Experiments have been made by the direct addition of the desired proportion of lactic acid, which is supposed to be the product of the bacteria which develops lactic acid, but with unsatisfactory results. It is evident that bacteria must do the work in a natural, progressive way, in order to produce the desired flavors. The importance of having the right kind of bacteria ripen the cream is so generally recognized that there are a number of bacteriologists in this and other countries who are devoting their entire time to making pure cultures of desirable species of the bacteria which form lactic acid and supplying these to butter makers, who use them to improve and maintain the flavor of their butter. While the industry is, as yet, a small one, it is increasing rapidly.

The flavor of butter made from clean and pure sweet cream is characteristic of butter fat. What flavor there is in such butter is dependent upon the character of the milk from which it is made, to a slight extent upon the period of lactation, and upon the feed of the cows. If these conditions are favorable, the flavor is mild and pleasant and is desired by many consumers. While sweet-cream butter is quite popular in some European markets, it is not much sought for in the markets of the United States and can usually be obtained only upon special orders.

There are many abnormal flavors that creep into butter in one way or another and which tend to lower its value for table use. The sources of some of these abnormal flavors are well known, while in other cases

they are still a subject of much speculation. It is, perhaps, not generally known how sensitive butter is to undersirable odors, not only after it is made, but even before the milk from which the butter is made is drawn from the cow. One prominent dairyman cites a case in which the abnormal flavor or taint was traced to some calf pens in front of the cows from whose milk this butter was made. The cows, breathing the tainted air, transmitted the undesirable odors to their milk and thence to the butter. Other taints come from the volatile oils of food eaten by cows. When these oils are pleasant, as in the case of clover and other foods, the flavor is desirable, but when they come from such vegetables as garlic, onions, cabbages, and turnips, from various weeds, stagnant water, etc., the imparted flavor is objectionable to most persons. In cases where the butter takes on a "fishy flavor" after a time, the cause is thought to be a fat-splitting enzyme, which is in the milk when drawn from the cow or is produced by organisms in the butter after it is made. Although bacteria can not live in any fat for more than a short time, the enzyme resulting from the bacteria does its work after the death of the latter. Salt which has absorbed disagreeable odors will impart them to butter in which it is used.

Whether or not the period of lactation of the cow exerts an appreciable influence upon the flavor of butter is still an open question. A number of carefully conducted experiments have apparently resulted in the negative. On the other hand, some butter makers whose product commands a fancy price hold that they prefer milk from fresh cows, even if it does not contain so much butter fat as that from a herd well advanced in the period of lactation. It is known that as the cow advances in her period of lactation the fat globules generally grow smaller in size and lighter in color and of a harder texture. The weight of evidence seems to make it probable that the stage of lactation has some influence upon the flavor of butter; yet it may be true that this influence can be entirely overcome by modern methods of butter making.

GRAIN, OR BODY.

The grain, texture, or body, of butter is perhaps less understood than any other of its attributes. It is unquestionably of greater importance than usually conceded, and probably exerts more influence upon the judgment of experts as well as of consumers than is generally recognized. The texture of butter should be firm and solid at temperatures ranging between 50° and 60° F. It should not be of the consistency of lard, on the one hand, nor of tallow, on the other, but somewhere between these two. Most makers aim to have it firm without being waxy, to the end that, when broken, the butter may have the fine granular appearance presented by broken steel. On the other hand, there are makers whose product commands the highest

price who aim to have their output as waxy as possible. This difference may be explained by the fact that the butter first described is made to be kept for some time before being consumed, while the latter sort is made for immediate consumption. It is thought that the butter in which the texture is so fine that the granular appearance is lost does not keep so well as that which has not been so much worked.

The body, or consistency, of butter should always be such that, when it is placed upon the table it can be easily spread upon bread or other articles of food with which it is usually eaten. This smeariness at a given temperature is affected by the period of lactation, by the breed of the cow (the animal playing a more important rôle in this single attribute of butter than in any other), and by the nature of her food. A class of foods, of which cotton-seed meal is typical, when fed in quantities ranging over 2 pounds per day to the cow, will produce butter that is hard and crumbly; but this tendency can be corrected by food of an opposite character, like linseed meal or wheat bran. The latter are representatives of a class of foods which tend to produce a comparatively soft, oily butter. It is interesting to note that the influence which food exerts is caused by a variation in the different fats composing butter fat. One class of foods increases the relative proportion of stearine, thus hardening the butter, and another class raises the proportion of olein, which softens the butter.

As cows advance in their period of lactation, the butter-fat globules become smaller and harder, thus affecting the texture of the butter correspondingly. It is commonly believed, although not conclusively demonstrated, that cows of the Jersey breed produce a specially firm butter and one that will resist the effects of a warm temperature.

The above-mentioned conditions will also have a bearing upon the churning temperature. Cream containing butter-fat granules that are small or hard will require a higher churning temperature than cream composed of fat globules that are large or soft. Butter which has not been subjected to temperature exceeding 58° or 60° F. in the process of manufacture will have a better texture than when allowed to become warmer during the making. This is an important consideration and one which all will do well to heed, as uncontrolled temperature is responsible for more bad butter than any other single factor in the making.

COLOR.

The natural color of butter varies from white to orange yellow, the shade depending upon the breed of the cow, and the character of her food. Next to nothing is known about the natural coloring matter in butter, hence it is impossible to control it to any appreciable extent. Nearly all of some breeds of cows, and some cows in nearly all breeds, will produce high-colored butter under good summer conditions and more or less color under almost all conditions. Other cows under

equally favorable conditions will produce butter extremely light in color at all times and practically colorless in winter. The want of uniformity in the natural color of butter has caused untold controversy in connection with oleomargarine as a substitute for butter.

THE EFFECTS OF SALT.

Nearly all the butter made in the United States is salted, although some is made without salt for special trade in large cities. The quantity of salt usually added is one-half to 1½ ounces to a pound of butter. The finished article will then contain from 1 to 3 per cent of salt, depending largely, however, upon the moisture held by the butter. What is known as the highest class trade demands a much lighter salted butter than is demanded for the lower grades. Furthermore, there is an increasing tendency on the part of the best trade to ask for a butter containing less and less salt. Butter which has a clean, pure flavor needs little salt; that which is "off flavor" or tainted in any way is improved by being strongly salted.

Butter is affected in four separate and distinct ways by the addition of salt—

First. It deepens the color; hence it is important that the salt be equally distributed to maintain uniformity in color.

Second. It acts in a slight degree as a preservative by preventing the growth of decomposing bacteria, which are always present in fresh butter. The preservative effect of salt in butter is, however, far less than generally supposed.

Third. Salt has a tendency to make butter actually drier, but not apparently so. When added to butter in the usual quantities, each grain of salt attracts to itself enough moisture to dissolve it, thus forming a drop of brine. These drops unite to form larger ones, which are pressed out when the butter is worked. In this way more water is removed from salted butter in the process of making than from unsalted butter, other things being equal. In this connection it is interesting to note that the moisture in unsalted butter is usually in such a finely divided condition that it can not be seen, and consequently such butter appears much drier than salted butter, which may actually contain much less moisture. It is therefore very difficult to judge the moisture content of butter by its appearance—by sight or touch. It is safe to assume, however, that butter in which no moisture can be seen is lightly salted and carries, in innumerable microscopic drops, more water than the average creamery butter contains. On the other hand, butter in which the moisture appears in large drops or which is "lacking brine" has probably had a larger percentage of water worked out in the course of its manufacture, and is really, though not apparently, drier than unsalted butter.

Fourth. Salt brings out the flavor of butter in a way that is demanded

in most markets of this country, although in France and southern Europe no salt is used in so-called "table butter" that is to be consumed within a few days after its manufacture.

It is highly essential that the salt used in butter-making should not only be nearly pure—that is, 99 per cent sodium chloride—but that it should be kept in a clean, dry place. If exposed, salt will readily absorb unpleasant flavors from such articles as fish, smoked meats, oil, and tar.

While most butter makers in the United States practice dry salting, there are a few here and more in England and Europe who salt their butter with a strong brine. The advantages of this method are that there is no fear that the butter will be gritty from undissolved salt, and as the salt is sure to be equally distributed there is no danger of mottles from this cause. The method is practiced only when a lightly salted butter is desired; it would be impracticable to salt butter heavily in this way. The disadvantages of brine salting are that it requires more salt and more time than dry salting and is less convenient. While it may be used in small dairies, it would be almost impossible to practice this method in large creameries.

Butter will usually weigh less after the salt has been added and the butter worked than before. This is due to the fact, already mentioned, that salt unites, or collects, the small drops of moisture into drops so large that they can be separated from the butter, and, as the total weight of the water or brine thus separated exceeds the weight of salt added, the butter consequently loses weight by reason of salting.

When butter is kept in a dry room in the winter time grains of salt will be frequently observed on the surface of the package or on the surface of the butter itself. When the latter case is observed, it may be seen upon examination that the butter at the surface is several shades darker than that below the surface, caused by an inequality in the distribution of the salt. Dry air draws the moisture containing the salt in solution to the surface of the butter, where it is evaporated, leaving the salt in crystals. The difficulty, if it can be called such, may be obviated by keeping the butter in a cool, moist atmosphere.

BUTTER FAULTS.

The ordinary faults of butter can be traced, with very few exceptions, to the process of manufacture, and not to the animal secreting the milk or to her food. Hence, when the sensitiveness of butter to foreign odors, bacteria, molds, etc., during the various steps of its manufacture is better appreciated many of the faults now apparent in butter upon our markets will be overcome.

The faults of butter may be divided into two general classes—faults of appearance and faults of taste and aroma.

One of the serious defects often found in butter is lack of uniformity

of color, or what is commonly known as "mottles." This defect is seen in white streaks, spots, or blotches, which are most pronounced when a lump of butter is cut so as to show a broad, smooth surface. If this cut surface is held at a proper angle to the light, any lack of uniformity in color will be plainly noticed. So serious is this defect considered that butter otherwise perfect, but mottled, is graded as second class in the large markets. The causes to which this fault can be attributed are, first, particles of curd, differing in size, incorporated in the butter, and, second, an uneven distribution of the salt. Mottles in creamery butter are seldom caused by specks of curd, but in the poorer classes of dairy butter this kind of mottles is not infrequently seen. They are most likely to occur when the cream from which the butter is made is thin and allowed to ripen without being stirred, or when it is overripened without being strained. The cream being churned under these conditions, lumps of coagulated cream are incorporated in the butter, and as the casein does not take the butter color the result is a product full of white specks. When the trouble is caused in this way it can be obviated by washing the butter twice in a weak brine after the buttermilk is thoroughly drained off. After the last washing, instead of draining the brine from the butter, as is usually done, the butter should be dipped out of the brine with a hair or wire sieve; the specks of curd, being heavier than butter or water, will have sunk to the bottom of the churn.

Most of the mottles found in butter, however, are caused by an unequal distribution of the salt. When the wash water is considerably colder than the butter granules the exterior of the latter become harder than the interior; this prevents an equal absorption of the salt when the butter is salted and worked, and mottles result. Also, when thin cream is churned at a low temperature the butter usually comes in round, shot-like granules; on account of being round and quite firm it is with difficulty that the salt is equally distributed and, unless great care is exercised, the finished butter is mottled. Of course, if under the most favorable conditions the butter is not worked enough to distribute the salt equally, mottles will be noticed in the finished product.

Mottles may be prevented, then, by avoiding high temperatures in ripening cream, by frequent stirring during ripening, by straining the ripened cream into the churn, by avoiding exposure of the butter to temperatures too low while in granular form (which causes a difference between the interior and exterior of the butter granules), and by working the butter sufficiently to cause an equal distribution of the salt.

Another common fault is seen in the milky appearance of the brine showing the presence of more or less albuminous matter in the butter, which not only detracts from its appearance, but also from its keeping quality. This fault may usually be overcome by a lower churning temperature, stopping the churn when the granules are about like

grains of wheat, and thoroughly washing with a weak brine having a temperature of about 5° lower than the butter at that time.

A salvy, smeary appearance of butter is a common fault. This is caused by overworking or by working at a high temperature, and is easily overcome unless, as is sometimes the case in home dairies, it is impossible to keep the temperature well down in the fifties during the process of churning and working. On the other hand, butter that is what is technically known as "short bodied"—that is, brittle, like tallow—has also a serious fault. This may be caused by feeding certain foods, like cotton-seed meal, in excess. Butter which has been churned at a low temperature, thus delaying the coming of the butter for a long time, or butter that has been very much overchurned, will be likely to have a greasy, lusterless appearance, a fault that is to be carefully avoided.

Much has been heard at times about moldy butter. This trouble is caused by distinct kinds of molds of various colors, the spores or germs of which are present in tubs and boxes made from improperly seasoned wood or those which have been held in damp storerooms. The fault is a serious one, but may be easily avoided by exercising proper oversight in the purchase and care of the packages or, in cases where the trouble is suspected as likely to occur, by treating the package and its parchment paper lining with a weak solution of formalin. Care should also be exercised to keep the butter, if stored, in a clean place.

The faults of taste and smell are not more serious, perhaps, than the faults of appearance, but are much more numerous and vary in degree from insignificance to the complete ruining of the butter. A most common one of these faults is the taste caused by the cows eating wild garlic or any similar taint-producing vegetable matter, but this may be remedied by specific treatment of the animal and its feeding which is now well understood. Tallowy butter is caused by the cows eating tallowy tasting meal or an excess of young green clover; this taste will also appear in butter that has been exposed to the light for some time, and also in butter that has been frozen and thawed several times. Other similar faults, such as sourness or "frowy," oily, fishy, cheesy, soapy, and smoky tastes and smells, are not uncommon. It is impracticable to describe specific causes and remedies for each of these faults. All are due either to lack of care or cleanliness, and indicate the want of skill or oversight somewhere in the process of manufacture. Patient investigation will develop the cause in any particular case, and the remedy is then likely to suggest itself.

PASTEURIZED-CREAM BUTTER.

The practice of making butter from milk or cream which has been heated to a temperature sufficient to kill practically all of the bacteria present has been carried on in Denmark for a number of years. This method, however, has made but slow progress in America, due par-

tially to the fact that consumers of butter demand a higher, stronger flavor than that produced by the Danish process, and partially to a lack of skiil on the part of the operators who first put it in practice here. It may have been, too, because pasteurization was often made a cloak to cover up filthy and slovenly methods of producing and caring for milk. Pasteurization can not be considered a panacea for dirt or carelessness, and butter makers who can not make good butter without pasteurizing can not expect to produce a superior product in that way if other conditions remain the same. As the principles of the method and the benefits to be derived from it become better understood, the practice of pasteurizing the milk or cream to be used for butter making is increasing in the United States.

The advantages to be derived from pasteurizing are that, when properly done, the butter is more uniform in texture and flavor, although the latter is comparatively mild. The importance of having butter uniform in these two particulars can not be overestimated. Again, butter made from cream which has been subjected to a heat of from 180° to 185° F. keeps much better than that made from cream not so treated, and hence is better for storage and for export. Another advantage of pasteurizing is that milk or cream heated to the above-mentioned temperature is freed from undesirable bacteria of all kinds, and as this includes all disease germs it is a source of comfort and security to the butter consumer. Disease germs are of rare occurrence in butter, however, in this country. An indirect advantage accruing from pasteurizing lies in the fact that, when all milk brought to a creamery or skimming station by patrons is pasteurized, it is a guaranty that the skim milk will not carry any pathogenic organisms back to the farm to infect the calves or pigs to which it is fed.

If, however, the cream that has been pasteurized is not properly cared for and ripened with a desirable ferment, or if the cream or milk is heated too high, the result will be disappointing and not so good as it might have been had pasteurizing not been attempted. Pasteurization does not change the composition of the butter to any appreciable extent. The only influence exerted in this respect is in the moisture content. It is believed that when milk or cream is heated to the extent necessary for pasteurization the butter usually contains rather less moisture than it otherwise would carry.

COMPOSITION OF BUTTER.

The average composition of butter is about as follows:

	Per cent.
Water	12
Fat	84
Casein, albumin, and sugar	1
Salt or mineral matter	3

Of course, unsalted butter contains but a trace of ash or mineral matter, and it usually contains about 1 per cent more of moisture than salted butter. The percentage of water is the most variable constituent, but when butter is well made under favorable conditions this seldom exceeds 15 per cent. If butter contains an excessive amount of moisture, it not only deceives the consumer, but will not hold its quality under ordinary conditions. On the other hand, butter which contains a low percentage of moisture (that is, from 6 to 9 per cent) will not, as a rule, have a well-developed flavor, and soon becomes tallowy. The highest quality in body and flavor is usually found to carry from 10 to 14 per cent of water.

Physically, butter is made up of a great number of minute fat globules, which have moisture adhering to their surface and held between them, and this water holds in solution casein and sugar and salt. It is estimated that a pound of butter contains from 720,000,000 to 180,000,000,000 of fat globules. Because the fat is in such a finely divided condition it is almost completely digestible and especially adapted for human food. Butter fat is made up of ten components, and this complexity distinguishes it from other fats—animal and vegetable. Its composing fats are of two classes—the volatile, which form but about 9 per cent of the total, and the nonvolatile fats. The relative proportion of the various fats is dependent, to a greater or less extent, upon the period of lactation, character of food and feeding, and exposure to inclement weather and other discomfort and excitement. The breed of the cow also seems to have some relation to the component fats.

Because butter is composed of so many different kinds of fats, it is easily decomposed, and, unlike other fats, this decomposition takes place sooner or later in spite of all known methods of preservation. The composition of butter, as well as its physical characteristics, is subject to considerable variation. These variations are brought about by the causes mentioned as affecting the changes in butter fat.

THE YIELD OF BUTTER.

Much has been said and written about the yield of butter from a given quantity of milk or cream. The yield of butter that can be produced will depend, within reasonable limits, upon the water that is incorporated during the process of churning, or the water expressed during the manipulation or working of the butter. It is not to be doubted that certain definite, fixed physical laws control both of these operations, but so far as generally known these have not yet been determined. It is known that water can be worked into butter by various means which have been employed by unscrupulous persons, but it is not generally known why the butter from a churning one day will contain 10 per cent of water and the next day a higher percentage

when the conditions governing both churnings are apparently the same. Therefore, if all butter contained the same proportion of moisture, and the work of manufacture was well done, all lots of milk or cream of the same composition would produce approximately equal quantities of butter. As a matter of fact, however, this is seldom the case, and, in instances where milks or creams differ in their composition, other conditions being equal, the richer milk or cream will yield proportionately more butter. The explanation of this fact is that there will be fewer pounds of by-products in the case of the richer milk or cream, and these by-products will be poorer in fat than in the case of the poorer milk or cream.

With the modern methods of manufacture, average milk should produce butter containing between 83 and 84 per cent of fat, and, in consequence, 100 pounds of fat in the milk should yield about 113 pounds of butter. This relates to average practice. The agricultural experiment stations have agreed that when all conditions are perfect, or nearly so, butter should exceed the fat churned by 16 per cent.

Fleischmann says that in churning sour cream with a fat content of 15 to 25 per cent, 97 or 98 per cent of the total fat in the cream should be recovered in the butter, but that when sour milk is churned but from 88 to 89 per cent of the total fat will be recovered in the butter. For estimating the yield of butter from both sour milk and cream where fat content is known, the same authority gives the following formulas: In the case of milk the yield of butter $X=1.05\times f.$, where f. represents the amount of fat in the milk. Where cream is used $X=1.155\times f.$ It is needless to explain why the yield is so much larger in the latter case. Any perceptibly greater yield than this is manifestly at the expense of the fat content of the butter, and a much less yield indicates a needless waste in some part of the process of manufacture.

JUDGING BUTTER.

Unfortunately, there is no exact method for judging butter; that is, there is no method which will give to the same butter exactly the same valuation if tested by a number of different judges. Butter is now judged, by more or less experienced men, by the senses of smell, taste, touch, and sight. None of these are exactly alike in any two persons, nor are they at all times the same in the same person, and according to these differences will the record of judging vary. Again, prejudices, likes and dislikes, enter in to bias judgment to a greater or less degree, although their influence is not recognized. Furthermore, so-called good judges will differ considerably in their standards of perfection. Consequently, while no better method is suggested, the result of judging butter, as it is done at present, is very unsatisfactory. It has been thought by some and hoped by others that there might be a definite relation established between the volatile fatty acids

of butter and its flavor and commercial quality, but recent European data seem to prove conclusively that no such relation exists. The most that can be said of the practical importance of the volatile fatty acids is that they are generally held to indicate the purity of butter and aid in detecting adulterations with other animal or vegetable fats; but even this matter is in dispute.

GRADES OF BUTTER.

The following classification and descriptions of the various grades of butter, extracted from "the butter rules" of the New York Mercantile Exchange, apply especially to that market; but they differ only slightly, if at all, from the rules and regulations governing other large distributing centers:

1. Butter shall be classified as Creamery, Imitation Creamery, Dairy, Factory, Renovated, Grease, and Known Marks, and shall be graded as Extras, Firsts, Seconds, Thirds, and Fourths.

2. The standard official score shall be as follows:

	Points.
Flavor	45
Body	25
Color	15
Salt	10
Style	5
Perfection	100

3. *Creamery butter.*—Butter offered under this classification shall have been made in a creamery from cream obtained by the separator system or gathered cream.

4. *Imitation Creamery butter.*—Butter offered under this classification shall have been churned by the dairyman, collected in the unsalted, unworked condition, and worked, salted, and packed by the dealer or shipper.

5. *Dairy butter.*—Butter offered under this classification shall be such as is made, salted, and packed by the dairyman and offered in its original package.

6. *Factory butter.*—Butter offered under this classification shall have been collected in rolls, lumps, or in whole packages and reworked by the dealer or shipper.

7. *Renovated butter.*—Butter offered under this classification shall be made by taking pure butter, melting the same, and rechurning with fresh milk, cream, or skim milk, or by other equivalent process.

8. *Grease.*—Shall consist of all grades of butter below Fourths, free from adulteration.

9. *Known Marks.*—Shall comprise such butter as is known to the trade under some particular mark or designation, and must grade as Extras if Creamery, and Firsts if Renovated butter, in the season in which it is offered, unless otherwise specified.

10. Packages must be sound, with full number of hoops, covers tight and properly fastened, or made so at the seller's expense, unless otherwise stipulated at the time of sale.

11. *Grades.*—Grades of butter must conform to all of the following requirements and shall not be determined by the score alone.

12. *Extras.*—Shall be composed of the highest grades of butter made in the season when offered under the different classifications; 90 per cent shall be up to the following standard; the balance shall not grade below Firsts:

Flavor must be fine, sweet, clean, and fresh, if of current make, and fine, sweet, and clean if held.

Body must be firm, smooth, and uniform.

Color, a light-straw shade, even and uniform.

Salt, medium salted.

Package, good, uniform, and clean.

Score shall average 93 points or higher during the months of May, June, July, August, September, and October, and 91 points or higher during the balance of the year.

13. *Firsts.*—Shall be a grade just below Extras and must be fine butter for the season when made and offered, under the different classifications, and up to the following standard:

Flavor must be good, sweet, clean, and fresh if of current make, and good, sweet, and clean if held.

Body, good and uniform.

Color, reasonably uniform, neither too high nor too light.

Salt, medium salted.

Package, good and uniform.

Score shall average 85 points or higher.

14. *Seconds.*—Shall be a grade just below Firsts, and must be good for the season when offered under the different classifications, and up to the following standard:

Flavor must be reasonably good and sweet.

Body, if Creamery or Dairy, must be solid boring; if Factory or Renovated, must be 90 per cent solid boring.

Color, fairly uniform.

Salt, may be high, medium, or light salted.

Package shall average 80 points or higher.

15. *Thirds.*—Shall be a grade just below Seconds.

Flavor must be reasonably good; may be strong on tops and sides (of packages).

Body, fair boring, if Creamery or Dairy, and at least 50 per cent boring a full trier, if Factory or Renovated.

Color may be irregular.

Salt, high, light, or irregular.

Package, fairly uniform.

Score shall average 75 points or higher.

16. *Fourths.*—Shall be just below Thirds and may consist of promiscuous lots.

Flavor may be off-flavored, and strong on tops and sides (of packages).

Body not required to draw a full trier.

Color may be irregular.

Salt, high, light, or irregular.

Package, any kind of package mentioned at time of sale.

17. *Grease.*—Shall consist of all grades of butter below Fourths, free from adulteration.

While the amount of butter sold on commission in the largest markets is decreasing year by year, all that is sold in this way is graded in a manner similar to the above. If the buyer and seller can not agree as to the grade of any lot, the question is settled by an official inspector appointed by the board of trade or the produce exchange of the local market. The question of weights is settled in the same manner.

As before stated, less butter is now sold on a strict commission than was formerly the case. Butter merchants at present, instead of depending upon consignments of butter to be sent to them to be sold

for a percentage of sales, go into the butter-producing districts and contract for the total output, or "make," of a creamery for the entire year or producing season at a fixed price, or at the highest current quotations of the market for which the goods are bought, or for so much above or below these quotations. The advantage of this practice is that it gives the merchant a reasonably uniform supply for his trade, and to the producer it gives the advantage of knowing what he is to expect for his product when it reaches the market, or even before.

BUTTER SUBSTITUTES.

At the present time there are three commercial substitutes for butter as it comes from the creamery or dairy churn. These are oleomargarine, butterine, and renovated butter. These substitutes are manufactured and sold under the surveillance of the United States Government, and are subject to special taxes. As is well known, oleomargarine is a mixture of various animal and vegetable fats, which is churned with milk to impart a butter flavor. The principal fats used are as follows: Oleo oil, a selected fat from beef that is obtained from the caul fat; this is thoroughly washed, well chilled in ice water, then cooked, cooled, and put into hydraulic presses by which the oil is extracted. "Neutral," or neutral lard, "is the leaf lard of the pig; the leaf fat, when taken out of the animal, is thoroughly washed and put into a refrigerator where it remains twenty-four hours; it is then well cooked, and becomes absolutely colorless and has neither taste nor odor." The vegetable fat commonly used is cotton-seed oil; "the oil is extracted from selected cotton seed and then highly refined."

Butterine is oleomargarine with which is mixed more or less butter. This is a purely commercial term, however, and not recognized by law. All "butterine" is legally oleomargarine.

Renovated butter is made "from one or more lots of butter which have been subjected to any process by which it is melted, clarified, or refined," for the purpose of removing rancidity, or any deleterious flavors, or of otherwise improving and rendering uniform miscellaneous lots of butter which could not find a profitable market without being subjected to some such process of renovation. It is understood that renovated butter is pure butter, but is made from stock that in itself is not fit for table use. The purpose of Government surveillance is to see that regulations are observed whereby no unwholesome material or process is used and so that the purchaser and consumer are advised as to the true character of this kind or grade of butter.

ADULTERATIONS OF BUTTER.

The adulterations that are usually found in butter are water, foreign fats, glucose, starch, and preservatives of one kind or another, such as

boric acid. A butter is deemed adulterated, under constructions placed upon laws of the United States by the administrative officers of the Government, when it contains more than 16 per cent of moisture, any foreign fat, or any chemical or other substance used for the purpose of removing rancidity or of cheapening the product.

The national laws concerning butter adulteration are so rigid and so well enforced that very little butter is now found upon the market, even of the poorer grades, which can be condemned as adulterated. The most common cases of adulterated butter are those where water in excess of the legal allowance is incorporated, either intentionally or unintentionally, during the process of manufacture or afterwards, for the purpose of adding to its weight. Martiny, an eminent German dairy authority, compiled the percentage of moisture in 17,332 samples of butter from analyses in various countries and found the average to be 13.55 per cent. From this it may be judged that it is exceptional to find butter naturally containing more than 16 per cent of moisture. The other adulterants are so rarely found that they need scarcely be considered in this connection.

HOME TESTS FOR BUTTER.

Housekeepers find it satisfactory to determine at home whether "butter" which has been purchased is genuine or counterfeit. Although there is more than one method of determination, the boiling test, as given in Farmers' Bulletin No. 131 of this Department, is the best one to repeat here. The experiment may be conducted in the kitchen as follows: Using an ordinary coal-oil lamp as a source of heat, melt a piece the size of a small chestnut taken from the suspected sample in an ordinary tablespoon, hastening the process by stirring with a splinter of wood (a match will do). Then increasing the heat, bring to as brisk a boil as possible, and, after the boiling has begun, stir the contents of the spoon thoroughly, not neglecting the outer edges, two or three times at intervals during the boiling, always shortly before the boiling ceases. Oleomargarine and renovated butter boil noisily, sputtering more or less, as a mixture of grease and water would naturally behave when boiled, and produce no foam or but very little. Renovated butter produces usually a very small amount of foam. Genuine butter ordinarily boils with less noise and produces an abundance of foam. The difference in regard to foam is, as a rule, very marked. A butter is rarely found which yields an uncertain result, but if uncertain it should be considered genuine butter or a case of suspicion not confirmed.

THE COST OF BUTTER.

The cost of producing a pound of butter varies widely under different conditions. So wide are these variations that it is almost impos-

sible to state, with any degree of definiteness, what is the average cost. Few producers can themselves tell, in anything more than a general way, how much net profit there is in butter dairying. This is mainly because so few take into account all the factors that have a bearing upon the cost, such as the interest on the value of the herd, deterioration in buildings and cattle, and labor of all kinds, including the time of owner or other members of the family. It will be readily seen that it requires considerable bookkeeping and careful judgment to form anything like an accurate estimate on all the items of cost involved in producing a pound of butter. Among the most reliable records are those published by the New Jersey Experiment Station, and even these do not strictly apply to butter making, as the figures are given for the production of hygienic milk and will have to be adapted to butter making as nearly as may be possible. This station gives $1 as the cost of 100 pounds of milk containing, according to test, 4.25 pounds of butter fat. If skim milk and buttermilk are reckoned at 20 cents per 100 pounds and their value deducted from the cost of the milk, the net cost of 4.25 pounds of butter fat will be 81 cents. This quantity of butter fat should produce 5 pounds of merchantable butter; hence the cost of producing the butter will be 16 cents per pound, plus the expense of labor. Three cents per pound is a fair estimate of the cost of making and marketing the butter. It is safe to assume that when butter is made under good conditions its cost in the Middle and Eastern States should be reckoned somewhere from 18 to 20 cents. Farther West, where feed is cheap, the cost will be less, and, although much farther from the markets, it actually costs less to put Kansas or Nebraska butter into the New York market by freight in refrigerator cars than it does to ship butter by express from near-by points to the same market.

It will be seen from the compilation of average New York prices for thirty-seven years that with good cows there has nearly always been a little money for the butter dairy. It should be borne in mind, too, that a great many dairymen in the East, where the cost of production is the greatest, have special customers for their product, at prices considerably above the average market price. On the other hand, the fact should be noted that a large part of the "dairy butter" (made on farms) is sold below the highest quotations, and much of it is probably the cause of actual loss to the producers.

PRICES FOR BUTTER.

During the past thirty-five years the total production of butter in the United States appears by the best statistics available to have increased approximately threefold. With this enormous increase in quantity there has been a corresponding increased demand. From various causes there has been great fluctuation in price. The follow-

ing table shows the variation in the highest price quoted for butter on the New York market for the past thirty-seven years:

Year.	Price.	Year.	Price.	Year.	Price.
	Cents.		*Cents.*		*Cents.*
1866	51.1	1879	25.5	1892	26.4
1867	41.6	1880	30.5	1893	27.2
1868	49.9	1881	32	1894	22.8
1869	47.3	1882	35.5	1895	21.3
1870	40.3	1883	31	1896	18.5
1871	35.5	1884	30.1	1897	19.0
1872	34.7	1885	26.8	1898	19.6
1873	39.4	1886	27.4	1899	21.4
1874	41.8	1887	26.9	1900	22.4
1875	34.8	1888	27.3	1901	23.3
1876	34.5	1889	24.2	1902	24.7
1877	30.6	1890	23.6		
1878	28.3	1891	26.2		

While there is no effect without a cause, the cause is in this case so complex that it is impossible to name any one of the many possible factors as having more influence than any other. There seems to be but little if any relation between the price of butter and meat, nor is there any apparent relation between the total population and the production of butter and its price. Two factors may be mentioned as probably influential in the fluctuations shown: First, irregularity of production, from various causes, giving markets a surplus at one time and at another causing some scarcity of supply; second, "the times," or the greater ability or willingness of the wage-earners to buy at one time over another, which results in a variation of the demand.

DISTRIBUTION OF BUTTER.

Only a small part of the butter produced is consumed at the place where made. This necessitates the shipment of much the greater part to populous centers and distribution to the consumer through various channels. The great butter-distributing markets are Chicago, New York, Philadelphia, Boston, and St. Louis; San Francisco will soon be added. Butter is sent to these markets either by freight or express, by rail or boat. From the large producing areas it is transported in through refrigerator cars, and reaches the cellars of commission merchants and distributers in prime condition. From these cellars it is sold to jobbers and retail merchants, who, in turn, sell to consumers.

A large part of the total butter produced is made during the summer months. To keep the surplus until winter, when there is a shortage in the production, it is put in large storehouses in the great cities and held at a temperature varying from 20° F. to well below zero. When held at a constant low temperature, the quality of the butter deteriorates but slowly. In consequence, butter made in May, June, and July,

when all the conditions are favorable, and put in cold storage or "freezers" for seven or eight months is better than the greater part of that freshly made during the winter months, when the conditions are often unfavorable. This system of storing or holding butter makes it possible to distribute advantageously through the period of comparative scarcity the enormous surplus of a few months' production.

DETERIORATION OF BUTTER.

Butter fat, and hence butter, is very unstable, and consequently begins to deteriorate soon after it is made. This deterioration continues until the butter is no longer fit for human food. Not all the conditions which combine to cause butter to spoil are thoroughly understood, and it is probable that the changes which occur in a spoiling butter are based upon causes partly chemical and partly bacteriological. It is believed that one or possibly both of these agencies may be hastened in their work by the presence of sunlight. Butter exposed to the light will take on a lighter color at the surface, which gradually spreads downward until finally the entire mass becomes somewhat bleached. As the butter loses color it develops a tallowy taste and odor. As the deterioration progresses the texture changes from a firm or solid condition to a semipasty mass. When this stage is reached the butter is, of course, fit only for soap grease. The acquirement of the peculiar flavor which is generally recognized as rancidity is usually included in the changes wrought by time, but this is by no means always so.

There are many ways by which these deteriorating changes can be retarded, but so far as yet known there is no process or method by which they can be entirely prevented. The most common and most successful way of preserving the quality of butter is by the method, already described, of storing it at low temperature and in a darkened place. Where successfully practiced this system will keep butter with comparatively little deterioration from six to ten months. On account of the expense involved this method is practicable in commercial and distributing centers only, where large quantities of butter and other perishable products can be cared for in one building.

To preserve butter that is to be shipped to tropical countries it is often made from pasteurized cream and packed in hermetically sealed cans. Butter made in this way will usually keep for a considerable length of time, although changes are quite certain to occur soon which will make the butter unpalatable to consumers accustomed to fresh butter. More or less butter prepared in this manner is also treated with a small quantity of some chemical preservative, such as borax or boric acid.

As has been stated, while butter can not be prevented from deteriorating, much can be done to retard this action by handling it in all

stages of its production under the utmost cleanly conditions, by pasteurizing the cream from which it is made, guarding it against infection by troublesome germs, packing in air-tight packages, and holding it at low temperature and in darkness.

CARE OF BUTTER.

The care of butter is a consideration worthy the attention of all who handle this important food product. A small quantity of butter cut from a large package and left exposed will soon lose its freshness and aroma. Butter packed in the form of bricks and wrapped in parchment paper will not retain its orignal aroma and flavor so long as butter that is put up in tight packages of greater size. Prints and pats are pleasing to the eye, but they are not sensible, unless the wrapping is uncommonly well done, so as to make an almost air-tight package. It should still be remembered that, as a rule, the larger the package or bulk of butter, the better it will keep. Small vessels of glass or glazed earthenware, with the least possible surface exposure of butter, are suitable for family use.

For household storage butter should be kept in a cold, dark place and separate from other foods which have any appreciable odor. If a refrigerator is not available, a vessel of pottery upon a cool cellar bottom is perhaps the best place. Special care should be taken to keep it away from places and things infested with mold of any kind.

BUTTER LAWS.

Twenty-two States and the District of Columbia have laws that apply directly to butter. Of these, seven merely define butter to mean "the food product usually known as butter, and which is made exclusively from milk or cream, or both, with or without common salt, and with or without additional coloring matter." (This is the wording of the United States law of 1886.) One State specifies that the coloring matter shall be harmless. Two States have legislated against the addition of "poisonous or deleterious substances," and one specifies that no boracic or salicylic acid or injurious antiseptics shall be allowed in the manufacture of butter. California, a State in which a great deal of butter is sold in two-pound rolls, requires that roll butter must be full weight. Connecticut's butter law states that "tub butter"—that is, originally packed in bulk—must be labeled "tub butter" when reworked and sold in the form of prints, pats, or rolls. The District of Columbia, besides defining butter as above, has a standard of 83 per cent fat and not more than 12 per cent of water or 5 per cent salt. Minnesota and New York butter laws specify that butter shall not be falsely branded. North Dakota requires creameries to brand each package of butter, giving quality of product; no false brands are allowed and all brands must be registered with the dairy commissioner.

Ohio and Oregon each have a butter standard, the former requiring 80 per cent of fat and the latter not allowing more than 14 per cent of moisture; Minnesota fixes 16 per cent as the maximum water content. Rhode Island's law states that all butter tubs shall be marked with their weights and makers' initials. Vermont does not allow butter to be branded "creamery" unless it is the product of a factory or creamery, although packages may be branded "private creamery" if the name of maker is also given. Virginia requires that butter inspectors shall brand lots of butter offered for inspection according to quality.

SUMMARY OF CONCLUSIONS.

Butter has been, is, and will long continue to be the principal feature of American dairying. Consequently any improvement made in this product will be a direct benefit to more dairymen than would profit from advance in other lines of dairying. The creamery, or associated system of manufacture, has done much to improve the quality of American butter, and if all butter came directly from creameries there would be no such quantities sold by producers at prices which are often actually below the cost of production, as is the case at the present time. Statistics for 1900 show that one-half of all butter reaching market in the United States was produced in private dairies, graded in the markets as dairy butter, and sold at least 3 to 5 cents per pound less than creamery butter. It is undoubtedly possible for butter made in home dairies to be as fine in quality as any creamery butter, and in many cases it is so, and commands prices accordingly. But a very small percentage of all dairy butter made is of really high grade. The essentials for successful home-butter making may be briefly stated as follows:

(1) Cleanliness, by which is meant not only clean utensils, but clean and well-ventilated dairy rooms, pure air, and freedom from all foreign odors that may taint milk, cream, or butter.

(2) Regularity in attention to the details of dairy work. Conditions should be under such control and the work be so regulated that every part of it is attended to at a fixed time. Further, the conditions regulating the ripening of the cream and churning should be such that when the fixed time arrives for doing certain parts of the work everything will be just ready to move along. "Order is heaven's first law," and in no place is conformity to this maxim more important than in the farm dairy.

(3) Low temperatures. The process of butter making, from beginning to end, affords favorable conditions for the development of various ferments. It is therefore essential to keep the temperature under complete control and within limits that will, on the one hand, favor the development of desirable bacteria, and will, on the other, check

and prevent the growth of the undesirable ferments. In this day of hand separators, where the cream that needs to be kept under control is but a small fraction of the milk from which it was taken, the desired conditions of temperature are easily obtained. If the temperature during the entire process of manufacture, from the time the cream is cooled after separation to the time the butter is packed ready for market, is not allowed to exceed 60° F., one important condition will have been met, tending to improvement of dairy butter.

(4) Ripening the cream. The quality of butter depends upon the proper ripening of the cream more than upon any other single step in the process of making. It is safe to say, too, that a person who is particular and successful in ripening cream will not be likely to lack in other requirements of a prime butter maker. All successful makers are now depending almost entirely upon a "starter" of some kind to ripen their cream. The present status of butter making would seem to indicate that the "starter" is almost necessary to make uniformly good butter. There are two classes of starters—the commercial and homemade—and either will give excellent results if properly handled. One or the other should be used by every butter maker who aims to produce a high-grade article. In connection with the "starter" in ripening cream may be mentioned the use of the acid measure to determine the amount of acid that has been developed. Experience has demonstrated that an insufficient amount of acid in the cream will fall short of giving satisfactory results, while too much will be detrimental. In order to know when the desired point in acidity is reached (and this is generally agreed upon as 0.55 to 0.65 of 1 per cent of acid), it is necessary to have some kind of an acid measure. The most convenient form of measure for home use is no doubt the Farrington alkali tablets, which may be obtained from almost any dairy supply house, with full directions for use.

THE COLD CURING OF CHEESE.[a]

By Henry E. Alvord, C. E.,
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INTRODUCTION.

The prevalent opinion among cheese dealers has always been that low temperatures, varying from 35° or 40° to 50° F., or thereabouts, resulted in the production of an inferior quality of cheese, in comparison with that from 60° to 70° F. No carefully controlled experiments bearing on this problem have been recorded earlier than those undertaken by Babcock and Russell at the Wisconsin Agricultural Experiment Station, and described in the Fourteenth (1897) Annual Report of that station. The results of those tests showed that cheese placed at refrigerator temperatures (45° to 50° F.),[b] directly from the press, was of superior quality as to flavor and also as to texture, and that such cheese was wholly free from any bitter or other undesirable taints.

In connection with their studies on the influence which galactase and rennet extract exert on the progress of cheese ripening, the same investigators later employed still lower temperatures (25° to 30° F.). Cheeses were kept at these excessively low-curing temperatures for a period of eighteen months. The quality of these cheeses, cured as they were below the freezing point throughout their whole history, was exceptionally fine, and emphasized still more than the previous experiments did the fact that the ripening of cheese can go on at much lower temperatures than has heretofore been considered possible.

These results led to an extended series of experiments, in which cheese made on a commercial scale was cured at a range of temperature from below freezing (15° F.) to 60°—a point which common practice has now accepted as the best obtainable temperature that can be secured without the use of artificial refrigeration.

In these experiments (consisting of five series made at intervals throughout a period of two years) 138 cheeses were used, for which 30,000 pounds of milk were required. These experiments were upon

[a] Appeared also in much more extended form in Bulletin 49, Bureau of Animal Industry.

[b] The first public presentation of these experiments was made at the meeting of the Wisconsin Cheesemakers' Association, in February, 1901.

a scale which represented commercial conditions, and therefore obviated the objection which is often urged in commercial practice against the application of results derived simply from laboratory experiments.

The results of these tests may be found detailed in Bulletin No. 94 and the Eighteenth (1901) and the Nineteenth (1902) Annual Reports of the Wisconsin Agricultural Experiment Station.

The Ontario Agricultural College began experiments on the cold curing of cheese in April, 1901. As a result of these tests, the conclusion was drawn that the cheese cured at low temperatures (averaging 37.8° F.) was much superior to that cured in ordinary curing rooms (average temperature during season 63.8° F.). Mr. R. M. Ballantyne, a prominent cheese expert, said of this cheese that "they [the merchants] universally expressed surprise at the condition of the cheese that was put into cold storage at the earliest period (that is, directly from the press), as they expected to find the cheese still curdy and probably with a bitter flavor." If this experiment is borne out by other experts, it would appear as if the best way to handle hot-weather cheese would be to ship it to the cold storage directly after making, and this would certainly mean a great revolution to the trade.[a]

A considerable number of experiments have also been made at other stations (Dominion government tests and New York State and Iowa experiment stations), where somewhat lower temperatures were used than those which are normally employed for ripening. The results obtained all show an improvement in quality that becomes more marked as the temperature is reduced.

In order that a much larger experiment might be instituted, covering the different types of cheese as represented by Eastern as well as Western manufacture, Drs. Babcock and Russell, of the Wisconsin Station, presented this matter for consideration to the Dairy Division of the Bureau of Animal Industry. As a result of this proposal the officers of the New York Agricultural Experiment Station were also consulted and plans perfected for the cooperative experiments conducted simultaneously in Wisconsin and New York, which are described in full in Bulletin No. 49 of this Bureau and special bulletins published by the two State stations. It should be noted that it was so late in the season of 1902 when the arrangements for this work were completed that it was impossible to obtain favorable conditions in all respects.

It was deemed desirable that the cheese to be tested should represent the product of as wide a range of territory as possible, and therefore it was decided to establish two curing stations—one in the East and the other in the West. Drs. S. M. Babcock and H. L. Russell were put in charge of the Western experiments and Dr. L. L. Van Slyke and Mr. G. A. Smith of those in the East.

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[a] Bulletin No. 121, Ontario Agricultural College, June, 1902.

OBJECTS OF THE EXPERIMENTS.

In addition to the influence which a range in temperature exerts on the quality of cheese, as determined by flavor and texture scores, instructions were also issued to secure data regarding the loss in weight which the different lots of cheese suffered at the different temperatures. The commercial quality of the product was to be determined by a jury of experts who were thoroughly in touch with the demands of the market. Although the effect of coating cheese with paraffin soon after being taken from the hoop was not at first proposed as a part of this work, it was finally included, both East and West.

The temperatures selected for these experiments were 40°, 50°, and 60° F. It may be assumed that the advantages of a cool and even temperature in curing Cheddar cheese have been already established in preference to a warm temperature or to very variable conditions which frequently include periods above 70° and sometimes much higher. As already stated, 60° or thereabouts is regarded as the lowest temperature practicable without artificial refrigeration; this may therefore be taken as fairly representative of what may be called a "cool" temperature for curing cheese. And rooms held at 40° and 50° were selected as representative of a "cold" temperature for curing, or comparatively so. It is thus hoped to emphasize by these experiments the distinction between cool curing and cold curing.

The cheese for these experiments was purchased by the United States Department of Agriculture, which also paid all expenses of transportation and storage and for the experts who made the periodical examinations. The two experiment stations selected the cheese, arranged all details of storage and examination, supervised the work throughout, performed the chemical and other incidental scientific work, kept the records, and reported results.

ADVANTAGES OF CURING CHEESE AT LOW TEMPERATURES BRIEFLY SUMMARIZED.

(1) The loss of moisture is less at low temperatures, and therefore there is more cheese to sell.

(2) The commercial quality of cheese cured at low temperatures is better, and this results in giving the cheese a higher market value.

(3) Cheese can be held a long time at low temperatures without impairment of quality.

(4) By utilizing the combination of paraffining cheese and curing it at low temperatures the greatest economy can be effected.

(5) The production of a thoroughly broken-down Cheddar cheese of mild, delicate flavor and perfect texture meets a demand which it is impossible to satisfy with cheese cured at high temperatures. Without any question, if the general market can be supplied with this mild, well-ripened cheese, consumption will be greatly stimulated, not only by increasing the amount used by present consumers, but by largely extending the use of this valuable and nutritious article of food.

EXPERIMENTS OF 1902-03.

The Western experiments were conducted by S. M. Babcock and H. L. Russell, assisted by U. S. Baer, of the Wisconsin Experiment Station. Suitable arrangements were made at the cold-storage warehouse of the Roach & Seber Company, Waterloo, Wis., where rooms were fitted up and the desired temperatures secured.

The Eastern experiments were conducted by L. L. Van Slyke, G. A. Smith, and E. B. Hart, of the New York Agricultural Experiment Station. The cheese was cured in New York City, arrangements having been made with the Merchants' Refrigerating Company to provide special rooms and take care of the different lots of cheese.

SELECTION OF THE CHEESE.

In order to cover the cheese-producing country of the East and West, samples were purchased in a number of the States in the neighborhood of each experiment.

In the West cheese of three types were secured:

I. Close-bodied, firm, long-keeping type, suitable for export trade (typical Cheddar).

II. Sweet-curd type.

III. Soft, open-bodied, quick-curing type, suitable for early consumption.

Type I represents the class of cheese that is especially manufactured in Wisconsin; while, as a rule, Type III represents the kind of cheese that is chiefly made in Michigan. The representatives of the sweet-curd type were taken from Iowa and Illinois, although this class is made to some extent in all sections.

Origin of cheese and quantities used in Western experiment.

Origin and type.	Style.	Number.	Weight.
I.—*Export type.*			
Wisconsin:			*Pounds.*
Boaz, Richland County	Flats	20	662
Muscoda, Grant County	do	18	571
Nicholson, Waupaca County	do	18	588
Alma, Buffalo County	Daisies	60	1,151
Do	Prints	40	400
II.—*Sweet-curd type.*			
Iowa:			
Union, Hardin County	Flats	20	607
Illinois:			
Sterling, Whiteside County	do	20	583

Origin of cheese and quantity used in Western experiment—Continued.

Origin and type.	Style.	Number.	Weight.
III.—*Soft, home-trade type.*			
Michigan:			
Merrill, Saginaw County—			*Pounds.*
I	Flats	9	287
II	do	9	287
III	do	29	924
IV	do	13	415

In having the cheese made at these various factories directions were given for the use of a uniform amount of rennet and salt. Color was left optional for each maker to follow his customary practice. The use of 3½ ounces of Hansen's rennet extract and 2½ pounds of salt per 1,000 pounds of milk was recommended in each case, with the exception of the smaller cheese (daisies and 10-pound prints), which were salted at the rate of 2¼ pounds per 1,000 pounds of milk. The cheese was made during the period from September 26 to October 4. The condition of the milk was influenced in several instances by the fact that severe frosts had occurred in some sections, which injured the quality of the product. This was particularly true in the case of the Alma cheese, which was in consequence somewhat tainted. The milk from which the Iowa cheese was made was also reported as of inferior quality. The Michigan goods were too high in acid, and were cooked low, making a soft cheese, which was quick curing and which kept poorly.

Origin of cheese and quantities used in Eastern experiment.

Origin.	Style.	Number.	Weight.
			Pounds.
I. Heuvelton, St. Lawrence County, N. Y	Cheddars	21	1,354
II. Turtlepoint, McKean County, Pa		40	1,794
III. Lowville, Lewis County, N. Y.:			
White		22	755
Colored		22	746
IV. Martinsburg, Lewis County, N. Y	Cheddars	20	1,301
Do	Stiltons	28	346
V. Triumph, Trumbull County, Ohio	Flats	34	1,242
VI. Turin, Lewis County, N. Y	Cheddars	40	2,825

These lots of cheese were as nearly uniform in rennet and salt as any that could be purchased. The rennet extract varied from 2½ to 3 ounces and the salt from 2 to 2½ pounds per 1,000 pounds of milk.

Lot I was made September 26. The milk was ripened to 4½ spaces by the Marschall rennet test at a temperature of 86° F. The curd was heated to 98° F. in forty-five minutes. One hour and twenty minutes later the curd showed one-eighth of an inch of fine threads by

the hot-iron test, when the whey was removed. The curd was then packed, drained, and kept for three hours, after which it was milled, salted, cooled to 80° F., and put in the press.

Lot II was made during the third week in September, and was therefore older when put into cold storage and did not get the full benefit of ripening at lower temperatures. In making the cheese a starter of lactic ferment was used and the milk ripened to about 5 spaces by the Marschall test.

Lot III, half colored and half uncolored, was ripened to 3½ spaces by the Marschall test. The curd was cut in twenty-five minutes and heated to 98° in fifty minutes, and after forty minutes showed one-eighth of an inch of string by the hot-iron test and was finished in the usual way.

Lot IV was normal in manufacture and consisted of 20 colored cheeses and 28 cheeses of the so-called Stilton style. (These are ordinarily known as "Young Americas.")

Lot V was made with 3 ounces of rennet extract for 1,000 pounds of milk, was cut in thirty minutes, then heated to 104° F. in thirty minutes, the whey being drawn an hour and a half later.

Lot VI consisted of 40 cheeses, each cheese weighing about 70 pounds. It was not at first intended to include a comparative trial between cheese in natural form and coated with paraffin (according to the increasing commercial practice), and no cheese was purchased by the Department of Agriculture for this purpose; but at the request of the New York Agricultural Experiment Station, and through the liberal cooperation of Messrs. Martin & Co., this was accomplished. Martin & Co. furnished this lot of cheese at their own expense and risk, but they were added to the five purchased lots, divided among the three curing rooms, as later recorded, and subjected to the same conditions and examinations as the rest. The cheese contained in this lot represented two different dates of manufacture one week apart—October 10 (A) and October 17 (B).

This lot of cheese was made at Turin, Lewis County, N. Y. The milk, of good quality in every respect, was warmed to 86° F. and a carefully prepared sour-milk starter added. It was then ripened to about 4 spaces by the Marschall test. Rennet extract was added at the rate of 2½ ounces for 1,000 pounds of milk. In twenty-five to thirty minutes the curd was cut, the cutting being somewhat fine, after which careful stirring was begun and continued until the pieces of curd were well separated and beginning to shrink. Heat was then applied, the temperature of 98° F. being reached in about forty-five minutes. Stirring was continued until the curd strung on the hot iron one-eighth of an inch, when the whey was removed. The curd was then matted, cut into pieces about 3 by 6 by 6 inches, and turned at intervals of six or eight minutes until the curd was well drained and solid. The curd

was then piled until it acquired a smooth, velvety feeling, after which it was milled, spread out, stirred, and cooled until fat started from it when squeezed in the hand. It was then salted at the rate of 2 pounds for 1,000 pounds of milk used, and finally put in press. Light pressure was applied at first—just enough to make the curd hold together in the form of the mold. At the end of one hour the cheeses were removed from the hoops, the cloths and outside of the cheeses rinsed with warm water, replaced in press, and pressure applied for eighteen hours.

This lot was placed in cold storage October 24, half of the number being covered with paraffin (Ap and Bp) and half being in natural condition (An and Bn).

When it was necessary to secure cheese from such a wide range of territory it was manifestly impossible to expect that the curing could be carried out as satisfactorily as if it had been done at or near the factories. The varying period of transit to which the cheese was subjected, with no especial temperature control, affected, of course, the initial stages of curing; but the conditions of the experiment prevented the carrying out of immediate installation of the cheese in the cold-curing rooms, although the shipments were made in October, when the temperature range was moderate.

SHRINKAGE OF CHEESE IN WEIGHT WHEN CURED AT DIFFERENT TEMPERATURES.

The losses in weight which cheese undergoes in the curing process is a matter of such practical importance that it is advisable, when possible, to accumulate data relating to it. This is all the more important in this connection because no studies have yet been reported on cold-cured cheese, and it was therefore deemed advisable to keep a record of the losses in weight so that the shrinkage at these lower temperatures might be compared with those which normally obtain at the best temperatures now employed. The average shrinkage under existing curing conditions in the majority of factories results in a loss of 5 to 7 per cent for the first thirty days, with a gradually diminishing rate for larger curing periods. This results in a heavy tax to the producer, and any factor which reduces these losses increases thereby the total receipts from the milk produced.

FACTORS INFLUENCING THE RATE OF LOSS.

There are a number of factors which modify the rate at which a cheese loses its water content during the course of ripening. The following factors are known to exert a more or less marked influence, although it is impossible to arrange them in order of their relative importance, as they are always interdependent: (1) Temperature of

curing room; (2) relative humidity of air in curing room; (3) size and form of cheese; (4) moisture content of the cheese; (5) protection to external surface of the cheese.

The influence of temperature is closely connected with the relative humidity of the curing room; but, in addition to the effect which the higher temperatures exert on this factor, it should be observed that water evaporates more rapidly at a high than at a low temperature, even though the relative humidity remains the same. The more potent influence of temperature is, however, the effect which varying degrees of heat exert on the relative humidity of the atmosphere. A fall of 20° F. from ordinary air temperatures practically doubles the relative humidity, provided the point of saturation is not passed. As the average relative humidity of the air is generally over 50 per cent, it therefore follows, in cold-curing rooms supplied with outside air, which is from 30° to 40° F. higher in summer than the inside temperatures, that the air of these rooms is practically saturated, thus greatly reducing the loss of moisture from the cheese.

So far as the cheese itself is concerned, the moisture of the room may be materially altered by the way in which the cheese is handled during the curing process. If the cheese is shelf-cured, as is the custom in most factories, the surrounding air more nearly approximates the average relative humidity of the entire room than is the case where the goods are box-cured. In the latter case the air is more nearly saturated, as is shown by the greater liability to mold and rind-rot.

This point is well shown in a series of observations in the Western experiments on the relative humidity of the air in a box containing a cheese placed directly therein from the press.

To show this the following observations were made: Wet and dry bulb thermometers (Hydrodeik) were placed in a Cheddar box with a 30-pound flat. An opening was made in the top and covered with glass, so that observations could be made directly without opening the box. The apparatus was placed for a period in rooms at different temperatures and the observations recorded as follows:

Relative humidity of air surrounding box-cured versus shelf-cured cheese.

	Temperature range.	Relative humidity.	
		Room.	Cheese box.
	° F.	*Per cent.*	*Per cent.*
Room I	35–40	85–92	100
Room II	50–55	55–75	94
Room III	60–69	50–70	84–90

A factor which is frequently overlooked is the varying moisture content of the cheese. The more moisture there is left in the cheese

the more rapid the evaporation. The varying moisture content of different types of cheese is determined by the temperature at which the curds are cooked, the time of exposure, and the acidity of the curd. A cheese in which the acidity is developed is materially drier than a sweet-curd cheese. Salt also has a tendency to diminish the water content. In the foregoing cases the cause of this diminution in moisture is due to the shrinking of the curd particles under the influence of these factors. An increase in fat lessens the drying of the curd. Much loss of moisture can also be prevented by coating the cheese with paraffin, a practice which is now coming into very general use for the prevention of mold and to lessen shrinkage in weight.

DISCUSSION OF RESULTS.

As there are several factors which affect the rate of shrinkage which the cheese suffers in curing, it will be desirable to discuss the data collected under several heads. The conditions of the experiment were such as to temperature that an especially favorable opportunity was had for the study of the influence which this factor exerts on the cheese. It is, of course, necessary in a study of this sort to have the cheeses uniform in size. The moisture contents of the cheese can not, of course, be made alike, but in this study the cheeses of the same type have been grouped together—that is, as firm Cheddars suitable for export and softer, moister cheese intended for home trade.

INFLUENCE OF TEMPERATURE ON SHRINKAGE.

To study the rate of loss of moisture of Cheddar cheese when kept at different temperatures, the cheeses were weighed at stated times. Much more data were collected on the cheese in the lower temperatures than on the 60° lot. This was regarded necessary, as up to this time there was no published data on cheese cured at so low a temperature. The following tables show the losses in the two experiments:

Losses at different periods in cheese cured at different temperatures—Western experiment.

Days.	Type I (typical Cheddar).			Type II (sweet-curd).			Type III (soft).		
	27 cheeses tested at 40°.	11 cheeses tested at 50°.	9 cheeses tested at 60°.	9 cheeses tested at 40°.	5 cheeses tested at 50°.	5 cheeses tested at 60°.	30 cheeses tested at 40°.	11 cheeses tested at 50°.	7 cheeses tested at 60°.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
10	0.38	0.92	0.96	0.69	1.02	1.05	0.49	0.92	0.85
20	.44	1.48	1.74	.82	1.60	1.77	.64	1.89	1.39
30	.58	2.00	2.05	.96	2.10	2.29	.84	2.35	1.75
60	.83	2.87	2.95	1.15	2.97	3.67	.98	2.98	2.77
90	1.00	3.64	3.57	1.42	3.60	4.47	1.21	3.55	4.02

Losses at different periods in cheese cured at different temperatures—Western experiment—Continued.

Days.	10-pound Prints.			20-pound Daisies.		
	5 cheeses tested at 40°.	1 cheese tested at 50°.	1 cheese tested at 60°.	24 cheeses tested at 40°.	17 cheeses tested at 50°.	7 cheeses tested at 60°.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
7	....	0.62	1.23	....	0.673	1.14
16	....	1.82	....	0.527	1.38	....
41	0.865	3.1	4.92	....	1.98	3.11
78	1.35	5.59	8.64	1.25	2.46	4.26
100	1.73	6.2	9.88	1.40	2.58	4.64
167	2.61	7.45	11.11	[a] 1.89	[a] 2.85	[a] 5.65

[a] 149 days.

Weight lost by cheese in Eastern experiment.

Lot.	Average weight of each cheese.	Age when placed in cold storage.	Age when weighed.	Amount lost per 100 pounds of cheese— At 40° F.	At 50° F.	At 60° F.
	Pounds.	*Days.*	*Weeks.*	*Pounds.*	*Pounds.*	*Pounds.*
I. New York export Cheddars	64	9	20	4.5	4.4	6.8
	64	9	28	5.3	6.0	....
	64	9	35	7.0	....	....
II. Pennsylvania Cheddars	45	18	20	2.7	3.7	5.1
	45	18	28	3.5	4.5	....
	45	18	35	4.5	....	....
III. New York flats (A) white	34	9	20	4.2	5.8	8.8
	34	9	28	5.6	7.2	....
III. New York flats (B) colored	34	9	20	3.0	5.4	8.2
	34	9	28	4.3	7.4	....
	34	9	35	6.2	....	....
IV. New York (A) large	65	8	20	4.4	5.4	7.3
	65	8	28	5.3	5.7	....
	65	8	35	6.8	....	....
IV. New York (B) Stilton	12.5	8	20	4.6	8.1	12.0
	12.5	8	28	6.6	11.1	....
	12.5	8	35	9.1	....	....
V. Ohio flats	36.5	....	19	4.6	6.6	9.0
	36.5	....	27	5.5	8.3	....
	36.5	....	34	7.2	....	....
VI. Export Cheddars (An.)	70	7	17	2.5	2.4	4.2
	70	7	25	3.1	4.0	....
	70	7	32	4.5	....	....
VI. Export Cheddars, paraffined (Ap.)	70	7	17	0.3	0.5	1.4
	70	7	25	0.6	0.9	....
	70	7	32	0.9	....	....
VI. New York Cheddars (Bn.)	70	14	17	3.4	....	....
	70	14	25	4.4	....	....
	70	14	32	5.3	....	....
VI. New York Cheddars, paraffined (Bn.)	70	14	17	0.3	0.5	1.5
	70	14	25	0.4	0.5	....
	70	14	32	0.7	....	....

From the data contained in the above tables we are enabled to make the following statements:

(1) The cheese continued to lose water in nearly every case so long as weighings were made.

(2) The loss of weight was least at 40° F. and increased with increase in temperature. The losses in weight of the larger cheeses in the Western experiment for a ninety-day period ranged from 1 to 1.4 pounds per 100 in the 40° curing room, while those in the 50° and 60° rooms shrunk from 3.5 to 4.5 pounds per 100. The prints at 40° lost 1.7 pounds per 100, the Daisies losing 1.4 pounds per 100 at 40° and 4.64 pounds per 100 at 60°. In the Eastern experiment the losses after twenty weeks varied from 2.7 to 4.6 pounds per 100 at 40° F., and at 60° from 5.1 to 12.0 pounds per 100, the latter being for the Stiltons, or Young Americas.

(3) The softer varieties, as shown in types II and III of the Western experiment, show greater losses than the firm Cheddars, especially at the higher temperature.

INFLUENCE OF SIZE AND FORM OF CHEESE ON SHRINKAGE.

The size of the cheese influences the loss of moisture. Small cheeses, other conditions being the same, lose a larger proportion of moisture in curing than do large ones, owing to the greater amount of surface relative to weight in the smaller cheeses. This tendency is shown by the following tabulated statements:

Weight lost per 100 pounds of cheese in twenty weeks—Eastern experiment.

Average weight of cheese.	At 40° F.	At 50° F.	At 60° F.
	Pounds.	*Pounds.*	*Pounds.*
70 pounds	2.5	2.4	4.2
45 pounds	2.7	3.7	5.1
35 pounds	3.9	5.9	8.5
12¼ pounds	4.6	8.1	12.0

Weight lost per 100 pounds of cheese in Western experiment.

Average weight of cheese.	Age of cheese.	At 40° F.	At 50° F.	At 60° F.
	Days.	*Pounds.*	*Pounds.*	*Pounds.*
32.5 pounds	90	1.00	3.64	3.58
20 pounds	78	1.25	2.46	4.26
	100	1.40	2.58	4.64
10 pounds	78	1.35	5.59	8.64
	100	1.73	6.2	9.88

INFLUENCE OF PARAFFINING CHEESE ON SHRINKAGE DURING CURING.

Within the last few years the custom of coating the cheese with an impervious layer has been suggested, with the object mainly of preventing the development of mold. For this purpose paraffin has been found to be the most suitable agent. The application of such a layer to the cheese not only prevents the growth of mold spores by excluding the air, but materially retards the rate at which the cheese loses its moisture. Paraffined cheese, therefore, dries out much more slowly than the untreated product, and the application of this method is of particular service in the handling of the smaller types of cheeses, which have a relatively larger superficial area exposed to the air.

The method of covering cheese with paraffin greatly reduces the loss of moisture. In the Eastern experiment the loss of moisture in large (70-pound) cheeses covered with paraffin was only 0.3 pound per 100 pounds of cheese at the end of twenty weeks at 40° F., 0.5 pound at 50° F., and 1.4 pounds at 60° F. In the smaller kinds of cheese the loss of moisture was greater at all temperatures.

In the Western experiment the 10-pound print cheese covered with paraffin had lost at the end of one hundred days 3.5 pounds per 100 pounds of cheese at 50° F., while the unparaffined prints had lost 6.2 pounds per 100 pounds. The loss of the 20-pound Daisies was not so marked. At the end of one hundred days the loss was 2 pounds per 100 pounds of cheese at 50° F. and 3.49 at 60° F., while the unparaffined lot lost 2.58 pounds per 100 at 50° F. and 4.64 pounds at 60° F.

By covering the cheese with paraffin the total loss of moisture can be reduced several pounds per 100. In addition, the use of paraffin prevents the growth of mold. In all cases cheeses covered with paraffin were entirely clear, while the others were more or less heavily coated with mold.

EFFECT OF TEMPERATURE ON THE QUALITY OF CHEESE.

Arrangements were made to have the cheese examined at intervals by commercial experts, who were to score the cheeses separately. In addition, Mr. Baer scored frequently the cheeses of the Western experiment. Unfortunately, different standards were chosen by the two sets of judges. In the West the basis of a perfect cheese was 45 for flavor, 30 for texture, 15 for color, and 10 for finish, while in New York it was 50 for flavor, 25 for texture, 15 for color, and 10 for finish. The results of the different scores are given in the following tables:

SUMMARY OF MR. BAER'S SCORES—WESTERN EXPERIMENT.

Summary of scores and values of cheese in Type I (firm export type).

Age in months.	Flavor (standard 45).			Texture (standard 30).			Price (standard 13 cents).		
	40°.	50°.	60°.	40°.	50°.	60°.	40°.	50°.	60°.
1	33.3	34.3	35.8	23.3	22.3	24.3	....	....	....
2	37	38.3	39	26	25.3	26.8	10	10.5	10.8
3	41.5	42.3	42.3	28.6	28.5	29	11.81	12.4	12.4
5	43	41	39.5	29.3	29	27.5	12.69	12	11.44
8	43.8	....	....	29	....	....	12.75	....	....

Summary of scores of cheese and values in Type II (sweet-curd).

Age in months.	Flavor (standard 45).			Texture (standard 30).			Price (standard 13 cents).		
	40°.	50°.	60°.	40°.	50°.	60°.	40°.	50°.	60°.
1	....	....	35	....	....	22	....	....	9.5
2	37.5	38	36.5	23.5	25	22	10	10.25	9.75
3	40.5	40.5	40	27	26	23.5	11.7	11.13	10.87
5	39	38	35	26	26	25	11	10.75	10.25

Summary of scores and values of cheese in Type III (soft Michigan cheese).

Age in months.	Flavor (standard 45).			Texture (standard 30).			Price (standard 13 cents).		
	40°.	50°.	60°.	40°.	50°.	60°.	40°.	50°.	60°.
1	....	....	33	....	....	23	....	....	9
2	32.6	35.3	37	21.7	22.7	23.3	9.3	10.2	10.5
3	39	39.5	40.2	26.3	26.3	25.3	11.25	11.4	11.5
5	37.7	37	37.7	25.8	25.5	25.5	10.4	10.2	10

Comparison of average numerical and commercial scores made by jury when the cheese was 3 and 5 months old—Western experiment.

FIRST JURY TEST (3 MONTHS).

	At 40°.				At 50°.				At 60°.			
	Flavor.	Texture.	Color.	Price.	Flavor.	Texture.	Color.	Price.	Flavor.	Texture.	Color.	Price.
Type I (typical Cheddar).												
Wisconsin:												
T. J., Boaz	41.3	25.8	11.8	12.3	43.3	27.6	14.3	12.6	42.3	28.6	14	12.4
H. J. N., Muscoda	42.3	26.3	15	12.2	44.1	27.8	15	12.6	43.6	27.8	15	12.5
P. H. K., Nicholson	44	28.6	14.8	12.8	44	28.3	14.6	12.6	43	26.3	14.2	12.3
La X, La Crosse	43.3	28.6	14.3	12.6	43	28.3	14.3	12.6	42	27.3	14.3	12.3
Total	170.9	109.3	55.9	49.9	174.4	112	58.2	50.4	171.9	110	57.5	49.5
Average	42.7	27.3	14	12.5	43.6	28	14.5	12.6	43	27.5	14.4	12.4

Comparison of average numerical and commercial scores made by jury when the cheese was 3 and 5 months old, etc.—Continued.

PIRST JURY TEST (3 MONTHS)—Continued.

	At 40°.				At 50°.				At 60°.			
	Flavor.	Texture.	Color.	Price.	Flavor.	Texture.	Color.	Price.	Flavor.	Texture.	Color.	Price.
Type II (sweet-curd).												
Iowa:												
E. G. H., Union	42.6	27.6	13.6	12.3	42.6	26.6	13	12.2	42.6	28	13.2	12.4
Illinois:												
J. B. G., Sterling	40.6	25.6	14.3	11.2	40	25	14	11.1	40	24.6	14	11.1
Total	83.2	53.2	27.9	23.5	82.6	51.6	27	23.3	82.6	52.6	27.2	23.5
Average	41.6	26.6	13.9	11.7	41.3	25.8	13.5	11.6	41.3	26.3	13.6	11.7
Type III (soft).												
Michigan:												
A. H. B., Merrill, I	39.6	26	13	11.9	40.6	26.6	13	12.2	41	26	13	12.2
A. H. B., Merrill, II	40.6	26.3	12.5	11.8	41.6	27.6	13.3	12.1	40	26.6	12.6	12
A. H. B., Merrill, III	40.3	27.3	13	11.3	42.6	28	13.3	12	40.3	26.3	13	11.5
A. H. B., Merrill, IV	42	28	13.6	12.3	41	26.6	12.6	11.8	42	27	12.6	12
Total	162.5	107.6	52.1	47.3	165.8	108.8	52.2	48.1	163.3	105.9	51.2	17.7
Average	40.6	26.9	13	11.8	41.4	27.2	13	12	40.8	26.5	12.8	11.9

SECOND JURY TEST (5 MONTHS).

	At 40°.				At 50°.				At 60°.			
	Flavor.	Texture.	Color.	Price.	Flavor.	Texture.	Color.	Price.	Flavor.	Texture.	Color.	Price.
Type I (typical Cheddar).												
Wisconsin:												
T. J., Boaz	43.5	28.5	15	12.8	40	28.5	15	12.5	38.5	28.5	15	12.4
H. J. N., Muscoda	44	29.5	15	13	43.5	28.5	15	12.9	43	28	15	12.8
P. H. K., Nicholson	41	28	15	12.6	41.5	28.5	15	12.6	42	28.5	15	12.8
La X, La Crosse	41	27.5	13.5	12.1	40	26.5	12.5	11.9	35	25	14	11
Total	169.5	113.5	58.5	50.5	165	112	57.5	49.9	158.5	110	59	49
Average	42.4	28.4	14.6	12.6	41.2	28	14.4	12.5	39.6	27.5	14.7	12.2
Type II (sweet-curd).												
Iowa:												
E. G. H., Union	41.5	26	13	12	39.5	25	13	11.5	......	......	......	......
Illinois:												
J. B. G., Sterling	38.5	24.5	13.5	11	39	25.5	13.5	11.1	39	25	13.5	11
Total	80	50.5	26.5	23	78.5	50.5	26.5	22.6	......	......	......	......
Average	40	25.2	13.2	11.5	39.2	25.2	13.2	11.3	39	25	13.5	11
Type III (soft).												
Michigan:												
A. H. B., Merrill, I	36	26	11	11.6	36.5	26.5	11.5	11.8	37	26.5	11	11.6
A. H. B., Merrill, II	40	26	11	11	38.5	25.5	11	11	37.5	25.5	11	11
A. H. B., Merrill, III	38	27	13	11.3	39.5	25.5	11	11.4	38.5	26	12.5	11.4
A. H. B., Merrill, IV	43	27	12	12.3	42.5	27.5	12.5	12.3	40.5	25	11	11.8
Total	157	106	47	46.2	157	105	46	46.5	153.5	103	45.5	45.8
Average	39.2	26.5	11.7	11.5	39.2	26.2	11.5	11.6	38.4	25.7	11.4	11.4

Results of scoring of cheese—Eastern experiment.

Lot.	Date of examination.	Temperature of curing room.	Flavor (standard, 50).	Texture (standard, 25).	Color (standard, 15).	Finish (standard, 10).	Total score.	Remarks.
		°F.						
I	Oct. 6, 1902	....	48	24	15	10	97	
	Dec. 15, 1902	40	48	24	15	10	97	
	....do.......	50	46.5	23	15	10	94.5	
	....do.......	60	46	22	15	10	93	
	Feb. 13, 1903	40	46.7	23.3	15	10	95	
	....do.......	50	44.3	23	14.7	10	92	
	....do.......	60	42.7	22	14.3	10	89	
	Apr. 10, 1903	40	46.3	23	14.7	10	94	Flavor not perfectly clean.
	....do.......	50	44.7	22.7	14.6	10	92	Flavor somewhat tainted.
	June 1, 1903	40	48	24.7	15	10	97.7	Clean flavor and silky texture.
II	Oct. 6, 1902	....	48	24	15	10	97	
	Dec. 15, 1902	40	48	23.5	15	10	96.5	
	....do.......	50	48	23	15	10	96	
	....do.......	60	47	22.5	15	10	94.5	
	Feb. 13, 1903	40	46	22	15	10	93	
	....do.......	50	45	22	15	10	92	
	....do.......	60	44	22	15	10	91	
	Apr. 10, 1903	40	45.7	22.3	15	10	93	Flavor not perfectly clean.
	....do.......	50	43.7	22.3	14.7	10	90.7	Flavor tainted.
	June 1, 1903	40	46	23	15	10	94	Flavor flat; texture smooth and silky.
III	Oct. 7, 1902	....	48	24	15	10	97	
	Dec. 15, 1902	40	48.5	24	15	10	97.5	
	....do.......	50	48	24	15	10	97	
	....do.......	60	46.5	33	15	10	94.5	
	Feb. 13, 1903	40	47.7	23.7	15	10	96.4	Flavor clean; texture wax-like.
	....do.......	50	47.7	24	15	10	96.7	
	....do.......	60	45.3	23.3	14.8	10	94.4	
	Apr. 10, 1903	40	47.7	24	15	10	96.7	
	....do.......	50	46.7	23.7	15	10	95.4	Flavor slightly bitter.
	June 1, 1903	40	47	24	15	10	96	Flavor clean; texture smooth and silky.
IV (A)	Oct. 8, 1902	....	47	23	14	10	94	Rather acid and of imperfect color.
	Dec. 15, 1902	40	47.5	23.5	14	10	95	
	....do.......	50	46.5	22.5	13.5	10	92.5	
	....do.......	60	44.5	22	13.5	10	90	
	Feb. 13, 1903	40	44.7	22.7	13.3	10	90.7	
	....do.......	50	42.3	22	12.3	10	86.6	
	....do.......	60	41.7	21.3	12	10	85	
	Apr. 10, 1903	40	46	23	14.7	10	93.7	Flavor acid; texture stiff.
	....do.......	50	43.3	22	13	10	88.3	Flavor acid and not clean; texture harsh; color imperfect.
	June 1, 1903	40	46	23	12.7	10	91.7	Flavor clean; texture smooth and silky; color light.

Results of scoring of cheese—Eastern experiment—Continued.

Lot.	Date of examination.	Temperature of curing room.	Flavor (standard, 50).	Texture (standard, 25).	Color (standard, 15).	Finish (standard, 15).	Total score.	Remarks.
		°F.						
IV B	Oct. 8, 1902	....	48	23	15	10	96	
	Dec. 15, 1902	40	48	23.5	15	10	96.5	
	.....do.....	50	47.5	23.5	15	10	96	
	.....do.....	60	46.5	22.5	15	10	94	
	Feb. 13, 1903	40	47.3	23.7	15	10	96	
	.....do.....	50	45	22	15	10	92	
	.....do.....	60	44	22	15	10	91	
	Apr. 10, 1903	40	46.3	24.3	15	10	95.6	
	.....do.....	50	46.3	24	14.7	10	95	
	June 1, 1903	40	46.7	23.3	15	10	95	Flavor clean; texture wax-like.
V	Oct. 13, 1902	....	46	23	15	10	94	
	Dec. 15, 1902	40	46.5	23.5	15	10	95	
	.....do.....	50	45	22.5	15	10	92.5	
	.....do.....	60	40.5	20.5	15	10	86	
	Feb. 13, 1903	40	45.3	21.3	14.7	10	91.7	
	.....do.....	50	43.7	20.3	14.7	10	88.7	
	.....do.....	60	43	20	14.7	10	87.7	
	Apr. 10, 1903	40	45.3	22	14.7	10	92	Flavor and texture imperfect.
	.....do.....	50	44	21.7	14.3	10	90	Slightly bitter and of weak texture.
	June 1, 1903	40	46	22.7	15	10	93.7	Flavor clean; texture smooth and pasty.
VI. An.	Dec. 15, 1902	40	49	24	15	10	98	
	.....do.....	50	48.5	23.5	15	10	97	
	.....do.....	60	48	23.5	15	10	96.5	
	Feb. 13, 1903	40	48	24	15	10	97	
	.....do.....	50	48	24	15	10	97	
	.....do.....	60	45.3	23	15	10	93.3	
	Apr. 10, 1903	40	48	24	15	10	97	
	.....do.....	50	48	24	15	10	97	
	June 1, 1903	40	47.7	24.3	15	10	97	Surface covered with mold.
VI. Ap.	Feb. 13, 1903	40	48	24	15	10	97	
	.....do.....	50	48	24	15	10	97	
	.....do.....	60	46.3	23.3	15	10	94.3	
	Apr. 10, 1903	40	48.3	24	15	10	97.3	
	.....do.....	50	48	24	15	10	97	
	June 1, 1903	40	48.7	24.3	15	10	98	Condition practically perfect; surface bright and clear.
VI. Bn.	Feb. 13, 1903	40	48	24	15	10	97	
	.....do.....	50	48	24	15	10	97	
	.....do.....	60	44.7	22.7	14.3	10	91.7	
	Apr. 10, 1903	40	48	24	15	10	97	
	.....do.....	50	47	24	15	10	96	
	June 1, 1903	40	47.7	24.3	15	10	97	Surface covered with mold.
VI. Bp.	Feb. 13, 1903	40	48	24	15	10	97	
	.....do.....	50	48	24	15	10	97	
	.....do.....	60	45.7	23	15	10	93.7	
	Apr. 10, 1903	40	48	24	15	10	97	
	.....do.....	50	47	24	15	10	96	
	June 1, 1903	40	48.7	24.3	15	10	98	Condition practically perfect; surface bright and clean.

A general summary of the average scores of cheese showing the effect of temperature on quality is given in the following table:

Averages of flavor and texture for the total experiment in the East.[a]

Qualities.	At 40°.	At 50°.	At 60°.
Flavor	42.7	41.8	40.3
Texture	28.1	27.6	26.6

Average of scores of Types I, II, and III of the Western experiment.

	Age (months).	At 40°.	At 50°.	At 60°.
Flavor (10 lots)	3	41.66	42.28	41.78
Flavor (9 lots)	5	40.65	40.05	39
Texture (10 lots)	3	27.01	27.24	26.85
Texture (9 lots)	5	27	26.75	26.4

[a] For comparison reduced to the standard used in the West, namely, flavor 45 and texture 30.

Good cheese was produced at all temperatures. Naturally that cured at 60° developed more rapidly than the goods cured at the lower temperatures, but it should be noted that even at this temperature some of the firm-textured cheese went off in five months. The 50° and 40° cheeses were behind the 60° in development, but in time reached as high as the 60° lot and were generally of a better quality, and kept this maximum condition much longer. This enhanced keeping quality was more pronounced at 40° than at 50°.

The variation in flavor shown at different temperatures was more marked than any other characteristic. At higher temperatures the flavor was more developed during the early ripening stages, but as the cheese increased in age the quality of the flavor at the higher temperatures deteriorated more rapidly than in the cold-cured, while the cold-cured cheese improved slowly.

The texture of the cheese followed quite closely a development similar to "flavor." At high temperatures the cheeses were subject to irregular ragged cracks. Plates XI, XII, XIII, and XIV show the texture of cheese cured in Western experiment.

The improved condition with reference to flavor and texture naturally reappears in the commercial standard, in which the 40° cheese, while developing somewhat more slowly, soon passes both the 50° and 60° and continues to improve, while the two latter decline toward the end of the experiment.

The effect of covering cheese with paraffin was in several cases to improve the quality as compared with cheese not so covered. The difference was more marked at 60° F. than at lower temperatures.

RESULTS OF USE OF PARAFFIN.—EASTERN EXPERIMENT.

Results of use of paraffin.

Character of cheese.	Age in weeks.	At 40° F.	At 50° F.	At 60° F.
Cheese, normal (An)	20	97	97	93.3
Cheese, normal (Bn)	20	97	97	91.7
Cheese covered with paraffin (Ap)	20	97	97	94.3
Cheese covered with paraffin (Bp)	20	97	97	93.7
Cheese, normal (An)	28	97	97	....
Cheese, normal (Bn)	28	97	96	....
Cheese covered with paraffin (Ap)	28	97.3	97	....
Cheese covered with paraffin (Bp)	28	97	96	....
Cheese, normal (An and Bn)	35	97	....	....
Cheese covered with paraffin (Ap and Bp)	35	98	....	....

WESTERN EXPERIMENT.

20-POUND DAISIES.

Curing temperature.	Age (months).	Flavor.		Texture.	
		Paraffined.	Unparaffined.	Paraffined.	Unparaffined.
40° F.	3	43.3	43.3	28.6	28.6
	5	41.5	41	27	27.5
50° F.	3	43	43	28.6	28.3
	5	40.5	40	26.5	26.5
60° F.	3	41.3	42	27.6	27.3
	5	39.5	35	28	25

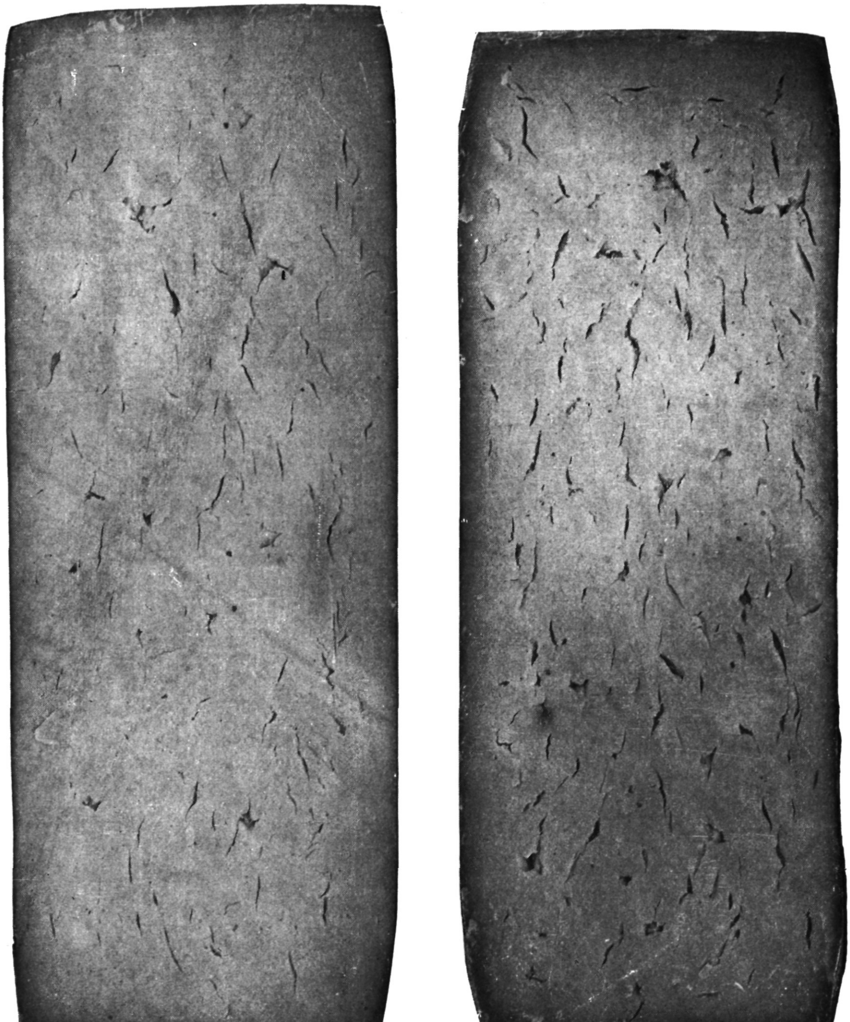
10-POUND PRINTS.

Curing temperature.	Age (months).	Flavor, paraffined.	Flavor, unparaffined.	Texture, paraffined.	Texture, unparaffined.
40° F.	1	38	38	22	22
	3	43.3	43	28.3	27.6
50° F.	1	38	38	24	24
	3	43.3	43.3	28.6	28
60° F.	1	40	40	25	25
	3	43.3	42.6	28.6	28.6

Increased value resulting from improvement in quality of cheese cured at low temperatures.—We have already studied the results of the scores furnished by the experts who examined the cheese from time to time. They were requested also to place upon the different lots of cheese a commercial valuation based upon the results of their scoring. Below we present these commercial valuations in tabulated form. The experts properly disregarded the actual market rates, which have fluctuations sometimes difficult to account for, and established as their constant basis of valuation 13 cents per pound for cheese scoring over 95 points, with the exception of Lot VI, which was a very superior class of goods.

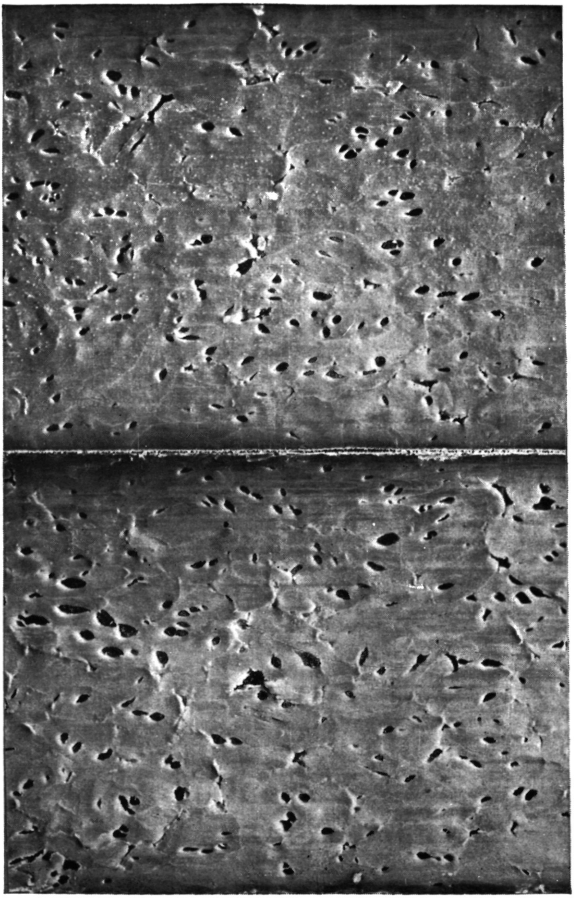
THREE CHEESE SECTIONS—TYPE I.

Cheese at top cured at 40°, in middle at 50°, and at bottom at 60°.



TWO VERTICAL CHEESE SECTIONS—TYPE I.

Cheese cured at 40° on left and cheese cured at 60° on right.



TWO CHEESE SECTIONS—TYPE II.

Cheese cured at 40° on top, cheese cured at 60° on bottom.

THREE CHEESE SECTIONS—ILLINOIS CHEESE.

Cheese at top cured at 40°, in middle at 50°, and at bottom at 60°.

Value of 1 pound of cheese.

EASTERN EXPERIMENT.

Date of examination.	Temperature of curing room.	Lot I.	Lot II.	Lot III.	Lot IV.		Lot V.	Lot VI.			
					A.	B.		An.	Ap.	Bn.	Bp.
	° F.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Dec. 15, 1902.	40	13	13	13	13	13	13	13.75	13.75	13.75	13.75
Do	50	12.75	13	13	12.50	13	12.50	13.75	13.75	13.75	13.75
Do	60	12.50	12.75	12.75	12	12.75	11.75	13.75	13.75	13.75	13.75
Feb. 13, 1903.	40	13	12.50	13	12	13	12.25	14.25	14.25	14.25	14.25
Do	50	12.25	12.25	13	11.75	12.25	12	14.25	14.25	14.25	14.25
Do	60	12	12.25	12.50	11.75	12.25	11.75	13.50	13.75	13.25	13.50
Apr. 9, 1903	40	12.75	12.50	13	12.50	13	12.50	14.75	14.75	14.75	14.75
Do	50	12.25	12.25	13	12	13	12.25	14.50	14.75	14.50	14.75
June 1, 1903	40	....	....	....	....	....	....	14.50	14.50	14.75	14.75

WESTERN EXPERIMENT.

Age when examined.	Temperature of curing room.	Type I.	Type II.	Type III.	Daisies.		Prints.	
					Unparaffined.	Paraffined.	Unparaffined.	Paraffined.
3 months	40	12.5	11.7	11.8	12.6	12.6	12.41	12.6
Do	50	12.6	11.6	12	12.6	12.6	12.5	12.75
Do	60	12.4	11.7	11.9	12.25	12.5	12.5	12.6
5 months	40	12.6	11.5	11.5	12.12	12.25	....	....
Do	50	12.5	11.3	11.6	11.87	11.87	....	....
Do	60	12.2	11	11.4	11	11.62	....	....

In studying the above data it will be noticed that the 40° and 50° cured goods had a higher value than those cured at 60° F. If the cheese cured at 60° had been kept for a longer period the decrease in value would have been serious. The decreased loss of moisture in the lower temperatures, together with the improved quality, makes quite a difference in the market value of the cheese.

The following table illustrates this very clearly:

Money returns at several temperatures.

Temperature of curing.	Cured cheese equivalent to 100 pounds of green cheese.	Market price of 1 pound of cheese.	Receipts from 100 pounds of cheese.
	Pounds.	*Cents.*	*Dollars.*
40° F	96.2	13.275	12.77
50° F	95.2	13.050	12.42
60° F	92.2	12.675	11.69

RESULTS OF CHEMICAL ANALYSIS OF CHEESE.

Analytical data were obtained only on the cheeses in the Eastern experiment.

The process of cheese ripening.—When cheese ripens, the most prominent change taking place is in the nitrogen compounds. The casein of milk is changed by the action of rennet enzyme into curd, chemically known as paracasein. In the process of cheese making lactic acid is formed, and this unites with the paracasein, forming a compound known as paracasein monolactate.[a] It is this compound that imparts to cheese curd the property of forming fine strings on a hot iron, and it is the formation of this paracasein monolactate that accounts for the changes in appearance, plasticity, and texture of cheese curd during the process of cheddaring. However, there is reason to believe that the changes that take place in the process of cheese ripening start with and are dependent upon the presence of paracasein monolactate or some similar compound. Hence, from a chemical point of view cheese ripening consists mainly of the change of paracasein monolactate into other forms of nitrogen compounds, chief among which, in the order of their formation, are paranuclein, caseoses, peptones, amido compounds, and ammonia. These compounds, formed from paracasein monolactate, are readily soluble in water, while paracasein monolactate is not. Hence, in ripened cheese we have larger amounts of substances that are soluble and smaller amounts of substances that are insoluble. Ripened cheese is for this reason believed to be more readily digestible than green cheese. The amount of soluble nitrogen compounds is used as a measure of the extent of cheese ripening.

This present investigation offers an opportunity for studying the chemical results of cheese ripening under different conditions of temperature and with a number of different types of Cheddar cheese under commercial conditions.

Moisture in cheese.—Before taking up a study of the nitrogen compounds of the cheese under investigation we will call attention to the amount of moisture in the cheese.

In the case of Lots I, II, III, and IV, in which the moisture was determined when the cheese was placed in cold storage, the moisture content was found to vary from 34.20 to 35.44 per cent; this may be regarded as a comparatively small variation. In Lots IV and V the moisture must have been above 40 per cent at the time the cheese was placed in cold storage, because ten weeks later, when the first analysis was made, the moisture was about 39 per cent. The result of moisture determination shows a gradual decrease in moisture as the cheese becomes older, as indicated by the following averages:

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[a] Bul. No. 214, N. Y. Agricultural Experiment Station.

Per cent of moisture in cheese.

	At 40° F.	At 50° F.	At 60° F.
When put in cold storage	36.50	36.50	36.50
After being in storage ten weeks	36.30	35.70	35.65
After being in storage twenty weeks	35.35	34.66	34.26

The decrease of moisture is greater with increase of temperature, a point which has been dwelt upon in connection with loss of weight.

Amount of paracasein monolactate in cheese.—The amount of paracasein monolactate formed in the different cheeses when one and two weeks old varied from 40.70 to 66.14 per cent of the nitrogen in the cheese and averaged 57.49 per cent. The amount decreased as the cheese aged, and more rapidly at higher than at lower temperatures, as shown by the following general averages:

Percentage of nitrogen in cheese in form of paracasein monolactate.

Age of cheese.	At 40° F.	At 50° F.	At 60° F.
1 week	57.49	57.49	57.49
10 weeks	47.94	42.08	37.09
20 weeks	47.10	35.24	30.77
28 weeks	40.54	31.82	....
35 weeks	36.36	....	....

This diminution of paracasein monolactate is undoubtedly due to its conversion into water-soluble nitrogen compounds.

Amount of water-soluble nitrogen compounds in cheese.—While the amount of water-soluble compounds of nitrogen in cheese is not a guide in respect to the detailed chemical changes taking place in ripening cheese, it serves as a general indication of the extent and rapidity of those changes. The data below, representing averages of our results, show that the amount of water-soluble nitrogen increases with increase of temperature and with lapse of time.

Percentage of nitrogen in cheese in form of water-soluble compounds.

Age of cheese.	At 40° F.	At 50° F.	At 60° F.
1 week	14.55	14.55	14.55
10 weeks	20.03	25.18	28.48
20 weeks	24.12	31.56	36.24
28 weeks	26.27	33	....
35 weeks	27.64	....	....

Amount of amido compounds in cheese.—The amido compounds of cheese are of interest, because it is possible that among these compounds we are to look for the substance or substances responsible for

cheese flavors. Little or no cheese flavor appears in cheese until amido compounds are formed. The amount of amido compounds increases with temperature and with lapse of time, as shown by the following averages:

Percentage of nitrogen in cheese in form of amido compounds.

Age of cheese.	At 40° F.	At 50° F.	At 60° F.
1 week	4.06	4.06	4.06
10 weeks	6.92	8.98	9.85
20 weeks	5.53	8.95	13.30
28 weeks	7.60	12.70	....
35 weeks	9	....	....

Amount of ammonia in cheese.—The formation of ammonia compounds in cheese may possibly be associated also with the development of cheese flavor. No ammonia is found in fresh cheese. It begins to be formed in appreciable quantities in about four weeks and increases with the age of the cheese. Its amount is greater at higher than at lower temperatures. The following averages give a good idea of the amount found in cheese under the conditions indicated:

Percentage of nitrogen in cheese in form of ammonia.

Age of cheese.	At 40° F.	At 50° F.	At 60° F.
1 week	0	0	0
10 weeks	1.20	1.87	1.97
20 weeks	1.62	3.44	3.26
28 weeks	2.52	3.48	....

SOME DETAILS OF PIG MANAGEMENT.

By George M. Rommel, B. S. A.,
Expert in Animal Husbandry, Bureau of Animal Industry.

INTRODUCTORY.

The climate and soil which will best favor the production of any kind of live stock are those in which the same kind of stock is found wild. In his native state the hog frequents those localities where vegetation is abundant if not luxuriant. The climate is usually one of only moderate severity. If extremes either of heat or cold are common, the environment provides shelter in the dense thickets in winter and shade and an abundance of water in summer. He is a heavy and promiscuous feeder, and, therefore, in his domestic state he thrives best where pastures are most luxuriant and grain crops, nuts, or roots are most abundant. The hog is not a ranger, nor does he thrive on grass alone; he can not endure a great amount of travel at a time; exercise he must have, yet he must be able to find his feed with only a small amount of searching, and water should always be easily accessible. During hot weather he craves a pool of water to reduce his temperature, for he perspires little; and in winter he wants shelter from storms. Owing to these requirements there are few hogs in the semiarid States of the West, and in that section hog raising is coincident with irrigation and alfalfa growing.

The first place in hog raising in the United States is easily with the corn-growing sections, and here corn is the first grain thought of when the fattening of animals, especially hogs, is mentioned. It is, however, fallacious to argue that hog feeding will not give profitable returns outside of the corn belt. The corn belt has wonderful advantages for economical pork production, but it also has its disadvantages, one of which is the bad effect on fecundity of feeding too much corn to breeding stock. Any locality that will grow clover of any species, that is favorable to the production of alfalfa, peas, or beans, or where grains are readily grown—not only corn, but barley, wheat, oats, or rye—will be a favorable situation for the successful production of pork. If it is a locality where dairying is common, no better advantages are required; for, given leguminous pasture—clover, alfalfa, peas, beans, etc.—as a basis, with a grain feed that can be readily grown and also dairy by-products, the very highest grade of pork can be produced at a minimum cost. Variety of feeds alone is an item of

immense importance in feeding. An animal tires of a constant ration of one kind, and is more easily put "off feed" at such times than when he is occasionally supplied with a change to keep his appetite keen. Not only has variety of feed an influence on appetite, but it results in a better quality of pork.

The few States comprising the corn belt are in reality the source of supply for a great amount of the meat product, especially hams and bacon, that is consumed in other portions of the country. Yet the advantages of many of these corn-belt States are little, if at all, superior to those outside of that district. The South has an abundance of vegetation. Cowpeas, velvet beans, and peanuts are leguminous crops that are peculiar to that section. Corn grows readily in all parts of the South, and in the subtropical portions the experience of feeders with cassava seems to indicate that it has considerable value for pork production. In addition, there is generally an abundant water supply; the climate is mild, and there is a long period during which green feed is available; the expense of shelter and winter feeding is very greatly lessened. These conditions, giving a long period of pasture and outdoor life, enhance thrift, and with proper management insure great freedom from disease.

In the extreme West the alfalfa of the irrigated valleys and the clover of the coast districts give a splendid foundation for successful pork production. In most of these regions there is an abundance of small grain, particularly barley, that may often be fed economically, while in some localities corn is a successful crop.

Barley is of so much interest and importance in the production of prime pork that it demands more than a passing notice. This grain has not been relied upon to a great extent in America as the principal part of a hog-fattening ration, but the practice of Danish farmers and the results of experiments can very well be studied with profit by American feeders. The Danish bacon, which figures so prominently in the English markets, is produced mainly with barley and dairy by-products. At the Ontario Agricultural College, Day has found barley so valuable in the production of prime export bacon that it is now used as a standard with which other grains are compared. In his experiments to determine the nature and causes of "soft" pork, Shutt found that the best bacon produced was by a ration in which barley was at least one-third of the whole amount. Farmers in those parts of the country where barley is a prominent crop can well devote attention to their opportunities for pork production; besides, in addition to this grain, some of the leguminous crops can often be grown for pasture, thus furnishing materials for a well-balanced ration.

The grain-growing districts of eastern Oregon and eastern Washington are instances of such localities. Corn is raised there to a very limited extent, but barley is an abundant crop and can be produced at

minimum cost, and often wheat may be utilized. In nearly all parts of this section there are irrigated valleys where alfalfa grows abundantly. Yet every town and city in this section imports immense quantities of pork products from the corn belt; indeed, it has been stated that 75 to 90 per cent of all the hams and bacon sold at Spokane are shipped in from the East; and when one remembers that this city feeds a very great territory it is readily seen how great is the dependence on the corn belt.

Recent investigations, the results of which have been published by Elliott, of the Washington Station, and Withycombe, of the Oregon Station,[a] show a greater feeding value for wheat than for barley. They seem to indicate that, under those conditions, it may be necessary to test barley further before its value is definitely determined. The grains were crushed in all cases. It would be interesting to note the effect of eliminating the hulls of the barley or feeding crushed bald barley in comparison with wheat or a mixture of wheat and corn. The bad effect of oat hulls on young pigs is well known. Possibly barley hulls had an injurious effect on the digestion in these tests.

The purpose of these remarks is not to minimize the value of corn in meat production of any kind. Corn is, perhaps, with a favorable climate and soil, the most economical grain that is at the command of the stock raiser and feeder of the United States. It is nutritious and highly palatable. Without its use it is difficult to imagine how the animal products of the United States could have attained their present position in the world's commerce; and so long as meat products are a factor of American agriculture corn will probably be a leading factor in meat production in this country, and the corn belt will naturally continue to be more or less the center of feeding operations. On the other hand, the condition is ever present that farmers in localities where corn is a limited product have their own wants to supply. If, in addition to their own needs, the farmers of these localities can supply a share of the export demand, great strides will have been taken in their agricultural development, for "live-stock husbandry is the foundation of successful agriculture." A market for the surplus is, of course, essential, but where a supply is available the market will probably grow up.

HOUSES, INCLOSURES, AND FENCES.

THE HOUSE AND ITS LOCATION.

Hogs are notably affected by extremes of heat and cold, and the character of their shelter will therefore depend on the locality. If the locality is one of severe winters, warm quarters are a necessity

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[a] Bul. No. 80, Oregon Expt. Sta., and Bul. No. 58, Washington Expt. Sta.

and an extensive piggery may be erected. Four things should be especially considered in its construction—(1) light, (2) ventilation, (3) warmth, and (4) cleanliness. Under cleanliness, ease of cleaning and dryness must be regarded. A well-drained location should be chosen; one that will give the hogs a good climb to reach it will provide needed exercise. The house should be on a north and south line, so that both sides may receive direct sunlight during a part of the day. Mr. John Cownie,[a] of Iowa, recommends a house with a wide driveway, with pens 6 or 8 feet square on either side opening into the driveway, and each pen provided with a window for light and ventilation. Mr. L. N. Bonham,[b] of Ohio, recommends a house with a row of sleeping pens on either side of a cement-floored alley, opening into feed pens floored with cement. The sleeping pens are floored with boards laid in gravel or cinders. Paving brick costs about twice as much as cement.

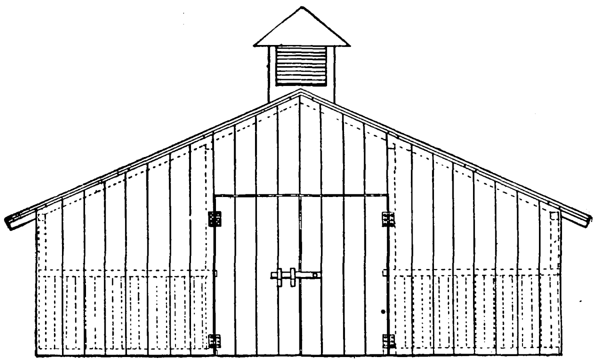

FIG. 1.—Hog house for Northern latitudes, end elevation.

Figure 1 shows a rough sketch of a house arranged on plans similar to these. Figure 2 shows the floor plan of the same house. The pens are 8 feet square. Each pen has two doors and a window. One door opens into the driveway and the other into the feed pen. If it is desired to protect the hogs from visitors, it may be found well to dispense with the door into the driveway, in which case the latter need not be wider than necessary to permit driving through with a wagon. The windows open downward. Ventilators are provided in the roof. The feed rooms are located in either end of the house. They should be at least as large as the pen, and may be on either side of the driveway or extend entirely across the end of the house. In the latter case the driveway should be dispensed with or made wide enough to enable a wagon to turn around in it. The width of the driveway will therefore depend on the presence or absence of this middle feed room.

[a] Thirteenth Biennial Report of Kansas State Board of Agriculture, p. 695.
[b] Breeder's Gazette, February 18, 1903.

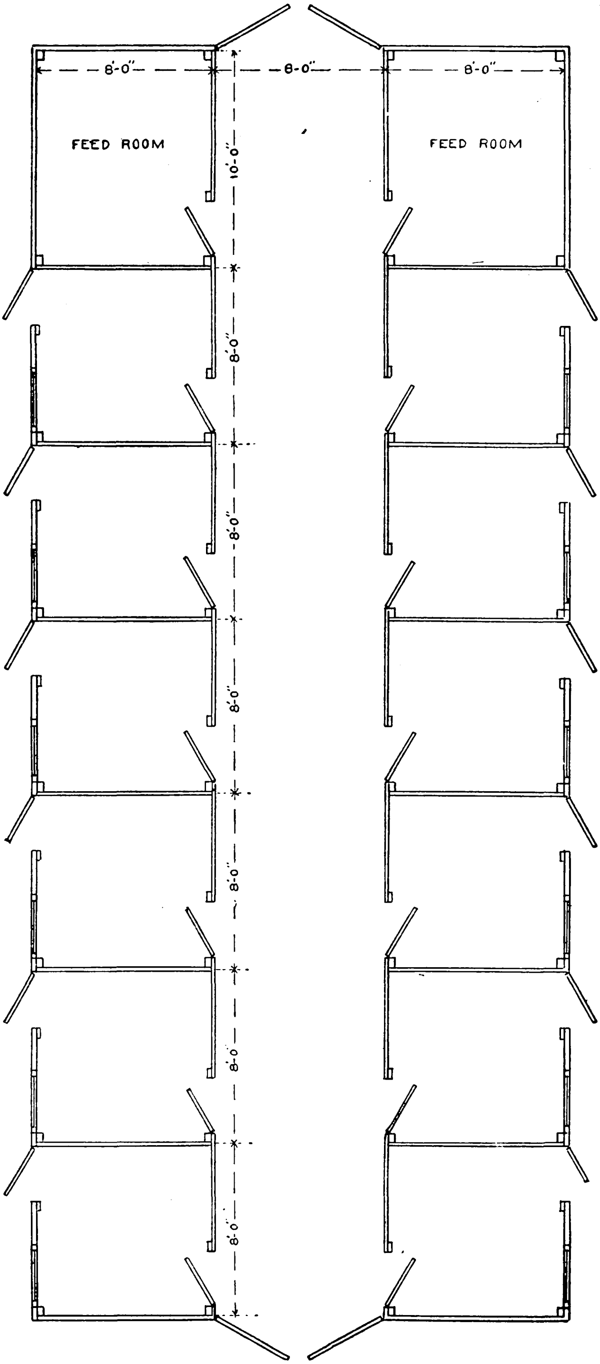

FIG. 2.—Hog house for Northern latitudes, floor plan.

If no other means of ventilation than the windows is provided they should be so arranged that entering air currents will be directed

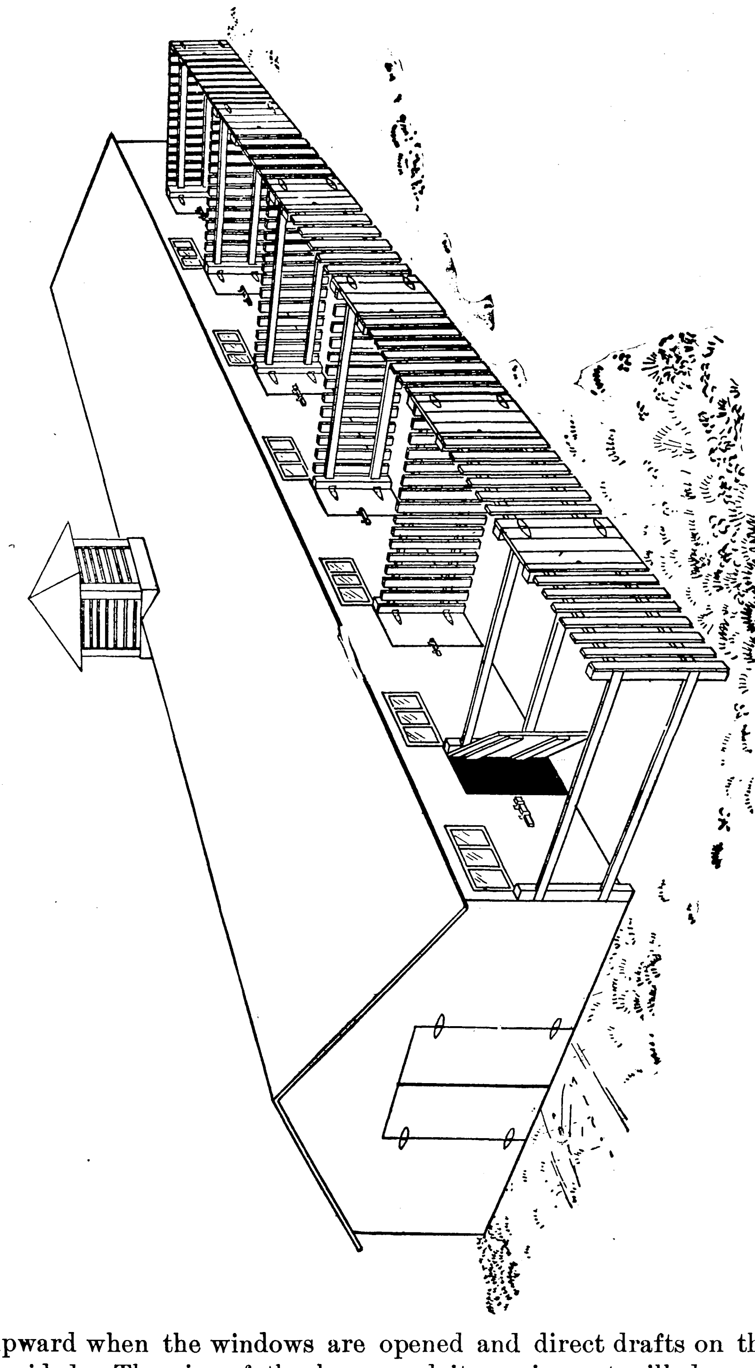

FIG. 3.—Hog house for Northern latitudes, side elevation; showing arrangement of outside feeding pens.

upward when the windows are opened and direct drafts on the hogs avoided. The size of the house and its equipment will depend upon

the size of the herd and the resources of the owners. Not more than fifty breeding hogs should be confined in one house; sanitary considerations make a smaller number much safer. Out of doors the number of hogs in one inclosure may be increased considerably above fifty without danger.

The arrangement of the pens will depend largely on the climate and the convenience. A very common plan is to have only the sleeping pens under cover, building feeding pens of the same size just outside the hog house and adjoining it. If these pens are floored substantially with concrete, they will last well. If the floor is properly laid, fitting closely to the posts and baseboards, there will be little danger of the hogs doing damage to the walls of the house by rooting, and rats will be prevented from burrowing under the walls.

Figure 3 shows this arrangement of pens for the house in figure 1. The advantage of this plan is that the sleeping and feeding pens are separate. The main part of the manure will therefore be left in the

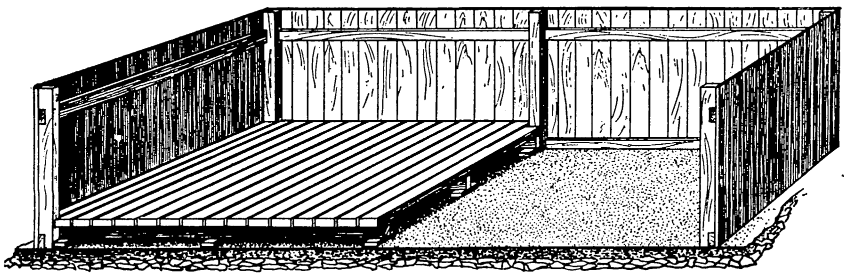

FIG. 4.—Pen arranged with sectional floor.

outside pens and can easily be removed. If separate feeding of the pigs is not necessary, the outside feeding pen need have no partitions. This arrangement will doubtless be more convenient for those who breed only for the market. The feeding pen connects with the pasture.

Where it is desirable to have both sleeping and feeding pens under cover, the pens in the house can be enlarged. A convenient plan for such a pen is used by the Michigan Agricultural College. The pens are 8 by 16 feet. A false wooden floor is built, of strong material, usually 2 by 4 inches, in two sections of equal size. This false floor is made small enough to fit conveniently into the pen, and rests on cleats in the bottom of the pen. As a rule only one section of the floor is used at a time, this part of the pen being kept bedded and used as a sleeping pen and the remaining part being used as the feeding floor. (Fig. 4.)

Under any circumstances the house should be well constructed and warm. If boarded up inside with good matched siding, such a house will be comfortable in zero weather, and sows may farrow there with

safety. Concrete or brick floors are expensive, but if the initial expense can be incurred and the floors are well laid they will pay good interest in the saving of manure and the dryness of the house. Animals should not be compelled to sleep directly on such floors, for rheumatism and colds are very likely to result. The best floor for a sleeping or farrowing pen is one of wood on concrete, the wood being 2 by 4 inch timbers, laid from one-fourth to three-eighths inch apart to allow drainage. If not constructed in this way concrete and brick floors should be kept well littered. A clay or ordinary earth floor is excellent, and by some preferred to any other. It is the warmest floor, but not so easily kept clean as one of brick or concrete. If a house is constructed with earth floors care must be taken that the floors are well drained, both underground and on the surface.

The greatest necessity for a good house is at farrowing time, for it is then that more pigs die than at any other. If the sow farrows in a damp or cold place or in drafts, serious results to the sow or the pigs or to both will follow. At this time the sow is seriously weakened, and she is very susceptible to exposure, while newly born pigs are easily stunted or killed by chilling. Rheumatic complaints are common with pigs, and are often caused by damp, chilly sleeping places.

PORTABLE HOUSES.

The portable house is coming into very general favor, especially in disease-infested districts. They are of various forms, and should be large enough for five or six grown hogs, with enough height to allow

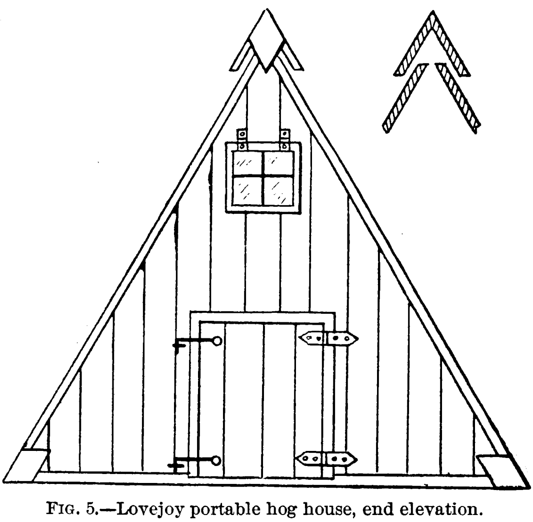

FIG. 5.—Lovejoy portable hog house, end elevation.

a man to stand erect; 6 by 6 feet or 8 by 8 feet are good sizes. Such houses should be strongly constructed of good lumber, with perfectly tight siding and roof. They may be made with or without floors. If

lined inside with the same materials as outside, such a house will be warm enough for a sow and pigs in zero weather; and on extremely cold nights a lantern hung in the house will provide warmth enough.

The plans for a portable house used by two successful breeders—Mr. A. J. Lovejoy, of Illinois, and Mr. L. N. Bonham, of Ohio—have recently been described in the agricultural press, as follows:

The Lovejoy pens or portable houses are each situated in the middle of an acre lot and on either side of a driveway, the divisions being made by the use of wire fencing. The houses are 8 feet square. Four 16-inch boards make the floor, and the roof and sides are made of matched flooring lined with building paper, and that covered on the inside with common lumber. The houses are set to front south. There is a door in both north and south ends, and a window in the south end, the latter being hinged at the top with a rope and pulley attached, so that it can be swung up out of the way when it is open. In cold weather and early spring the north door is closed, and, if necessary, the south openings are also closed, fresh air being secured through the ventilator in the roof by carrying the ridge a trifle higher than the sides that comprise the roof. [Fig. 5.]

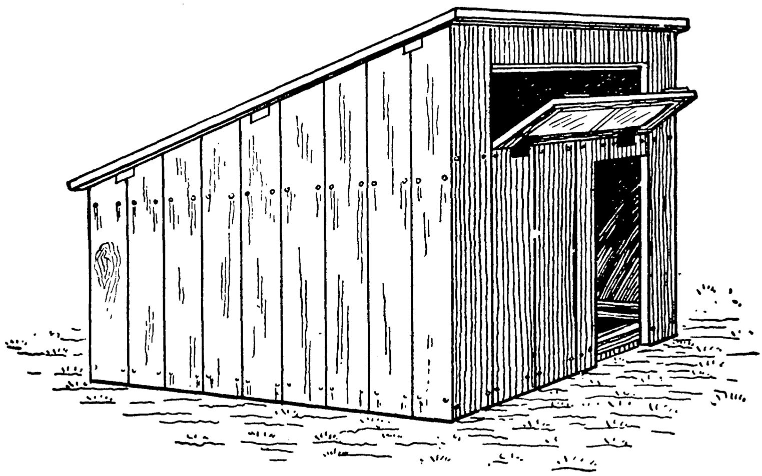

FIG. 6.—Bonham portable hog house.

In hot weather the houses are converted into summer resorts by leaving both doors and window open. Each house is nicely painted with two coats and trimmed in white, and costs, complete, about $10. They are set up on blocks in the summer to keep the floors dry, and in the winter time they are dropped to the ground and banked to keep the wind out from under the floor.

The primary object of the Bonham pig house is to secure shelter, warmth, sunshine, and pure air at reasonable cost, and the secondary object is to have it as handy for feeding and handling the sows and pigs as possible.

For some sows the main roof may be shortened 18 inches. This will give a pitch to the front, and a sash 6 by 1½ feet in front to let in the sunlight and keep out the rain and cold may be provided. This adds a little to the cost, but makes an ideal shelter for spring litters, when sunshine is never in excess and of inestimable value. In very cold weather we add a swinging door, but a gunny sack hung at the top of the door will do. If the weather is below zero and windy, a lighted lantern hung to the roof inside until the pigs are dry and have had their first meal of the sow's milk will

keep them comfortable in the coldest weather. The warmth of the sow is sufficient in other weather to keep the pigs comfortable in such a pen.

This house is 5 by 6 feet. Four scantlings 2 by 2 inches by 12 feet, and two scantlings 2 by 4 inches by 12 feet will make the frame and roof supports. The bottom rail is 2 by 4 inches, the others 2 by 2 inches. The three pieces for the roof are cut 6 feet by 6 inches to give a 3-inch projection of the roof beyond the sides.

[Figure 6 shows the house set up and the drop window partly down. Figure 7 shows the top off.] The construction is readily seen. After the house is ready to set together have the floor made just large enough to let the sides of the house set outside the floor. The cost of this house is about $5. It pays to paint the roof every three years, but the sides will last without paint as long as the roof is well painted. Taken down each fall and spring and whitewashed and set up against a fence or in a shed until needed, it will give long service.[a]

A chief advantage of a portable house over the piggery system of several pens and a large number of hogs under one roof is its ease of management in times of epidemic. Only a few animals can be kept

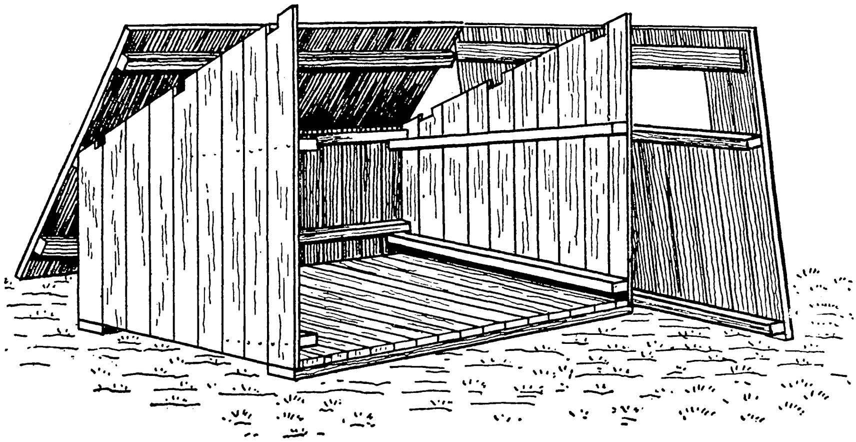

FIG. 7.—Bonham portable hog house, showing plan of construction.

in one pen, and the isolation of the diseased animals when an outbreak begins is thus rendered comparatively easy. When cholera breaks out in a crowded piggery every animal in the building is exposed, and the farmer, though he may isolate the unaffected animals at once, does not know how soon the second outbreak will occur; he has no check whatever on the epidemic. But with portable hog houses each house is itself a cholera check, and only infection directly from diseased animals can spread the disease.

HOUSING IN MILD CLIMATES.

In the South and in much of the country west of the main chain of the Rocky Mountains the winters are sufficiently mild to obviate the necessity of constructing buildings of much warmth. Not only are

[a] Breeder's Gazette, January 6, 1904.

the winters mild, but they are comparatively short, and green feed is available much longer than in other parts of the country. In such localities a shed will often suffice, but it should be well constructed, in order to provide protection from storms and damp, chilly weather.

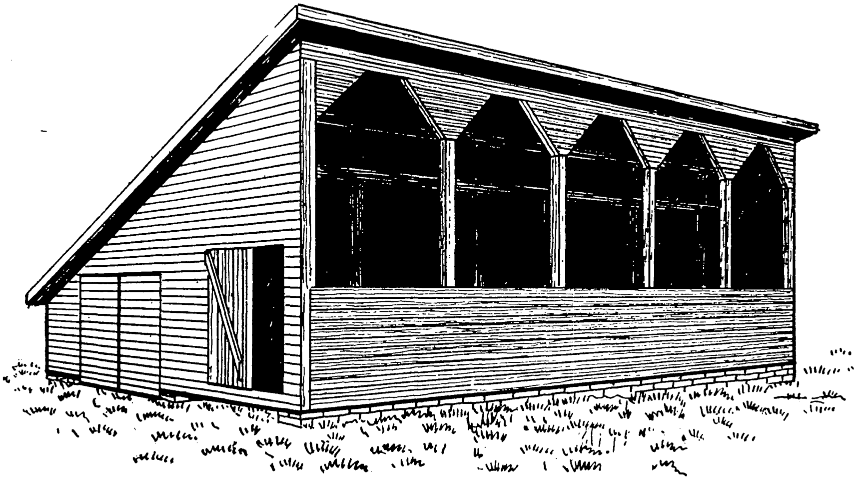

FIG. 8.—Hog house for Southern latitudes.

The location, as that of a piggery, should be high and well drained, affording clean, dry sleeping places; the shed should open to the south. The expense of such a building is well warranted in view of the added comfort to the stock and increased number of pigs raised. Under all

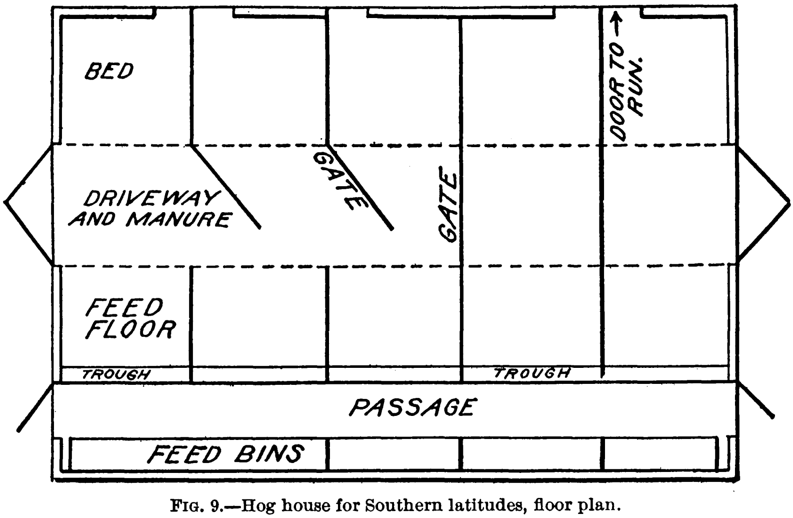

FIG. 9.—Hog house for Southern latitudes, floor plan.

circumstances, regardless of climate, whether a man is breeding purebred stock or grades, hogs should have sleeping places that are dry and warm and feeding places that are clean.

Figure 8 shows the elevation of the house used by the Maryland Agricultural College, at College Park, Md., and figures 9, 10, and 11 show the ground plan, the end elevation, and the arrangement of the

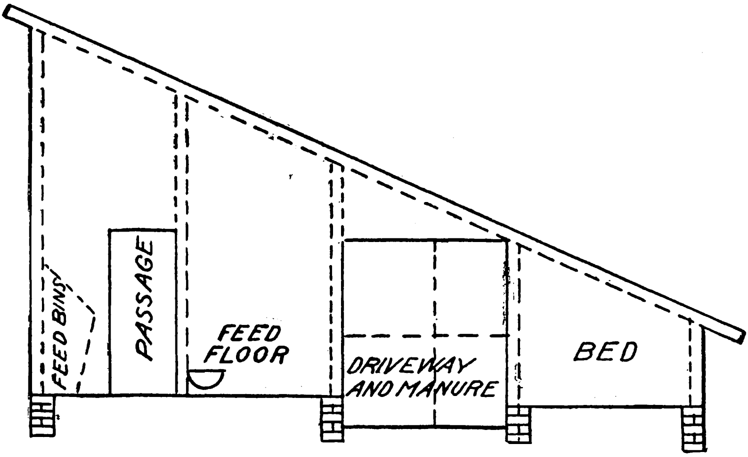

FIG. 10.—Hog house for Southern latitudes, side elevation.

troughs and feed bins.[a] The front faces south, and is open and raised sufficiently to allow the sun's rays to penetrate to the extreme end of each pen. Sunlight and ventilation are thus provided by the same

FIG. 11.—Hog house for Southern latitudes, showing arrangement of troughs and pens.

means. The feed bins are placed against the front of the house, a passageway intervening between this and the pens. The pens have

[a] From Bul. No. 63, Maryland Expt. Sta.

swinging fronts, so arranged that the feed can be placed in the troughs and evenly distributed before the pigs get to it. Back of the feeding floor is a depressed driveway, which is kept well bedded, and serves also as a manure pit, and at the rear of the house are the sleeping pens, from which doors open into the yard. The feeding floor and sleeping pens slope slightly toward the driveway. The gates of the sleeping pens extend entirely across the front and are the same width as the driveway. These gates are opened across the driveway except when cleaning; at this time the hogs are driven into the sleeping pens or on into the yards, the gates of the pens closed on them, and the cleaning proceeds with no interruption from them. The gates and partitions between the pens are constructed in lattice fashion, which allows free circulation of air.

TROUGHS.

Well-made troughs are a necessity in pig feeding. The time-honored V-shaped trough (fig. 12) is very common and doubtless familiar to all who handle hogs. Some farmers use troughs made of logs (fig.

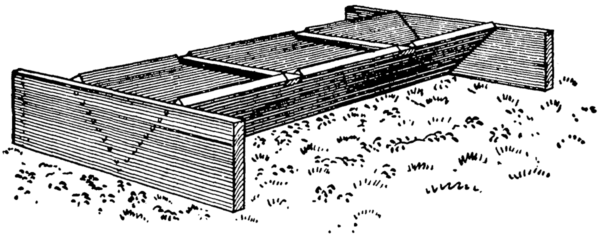

FIG. 12.—V-shaped trough.

13), which are adzed off on one side to give a level resting surface and hollowed out on the other. This is a durable trough, but it is very cumbersome.

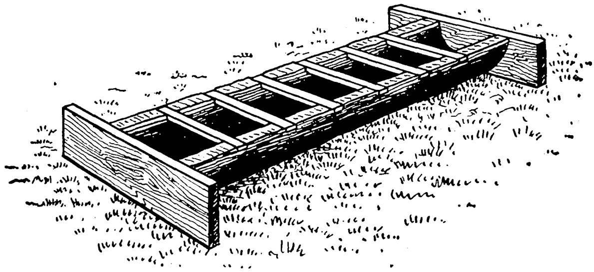

FIG. 13.—Log trough.

Theodore Louis advises the use of a low, wide, shallow trough (fig. 14). Troughs should not be so long that they can not be handled by one man, and they should be so strong that they will not readily be broken to pieces by the pigs.

A very convenient arrangement of the feeding troughs is shown in the drawings of the Maryland Agricultural College hog house. The troughs extend across the front of the pen and are built solidly, so that they will not be displaced. The front of the pen is hung on hinges, and attached to it is a strong iron rod which fits into holes in the edges of the trough and holds the pen front firmly. When feed-

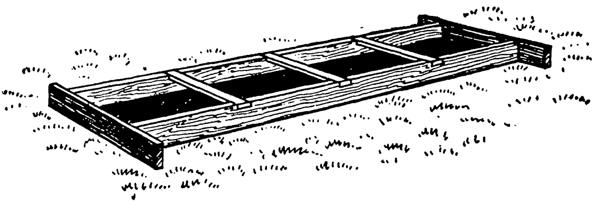

FIG. 14.—Shallow trough.

ing the pen front is swung back and the rod inserted in the edge of the trough. The pigs can not then get to the feed until the front is lowered. The plan permits feeding without being disturbed by the eagerness of the animals, and the feed is evenly distributed. (See figs. 11, 15, and 16.)

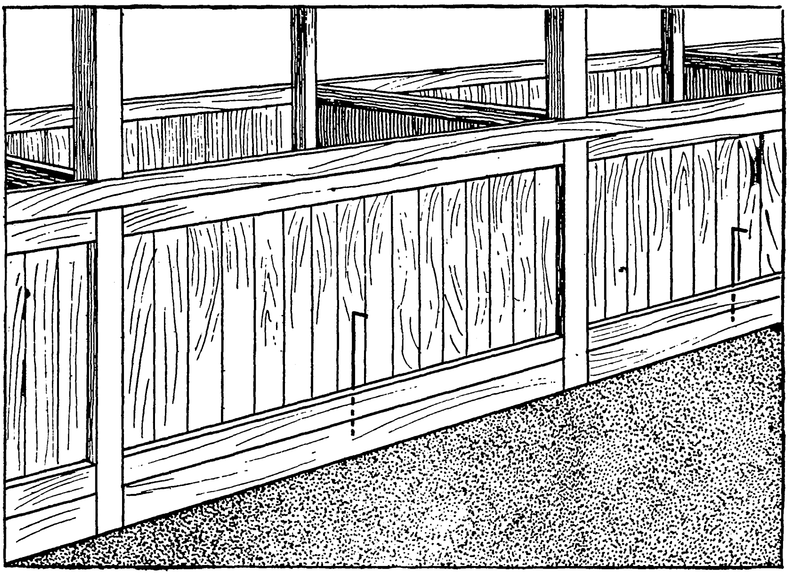

FIG. 15.—Pen with swinging front, closed.

Wooden troughs are objectionable in some respects. They are not very easily kept clean and are not durable. Iron troughs are used to a considerable extent and have much to commend them. They are more sanitary than wooden ones, and with proper care will last indefinitely.

PENS AND PASTURES.

The question of pens and pastures, both as to size and location, must be determined by each one for himself. Local conditions, expense, and convenience must be considered. A good rule to follow is to favor large inclosures rather than small ones. A number of pens and several pastures will be found a convenience and are particularly valuable when disease makes its appearance, as hogs affected may then be removed at once. A quarantine pen with an absolutely tight fence should be arranged on every farm where hogs are kept. Here all newly purchased hogs should be confined after arriving at the farm until all danger of infection is past.

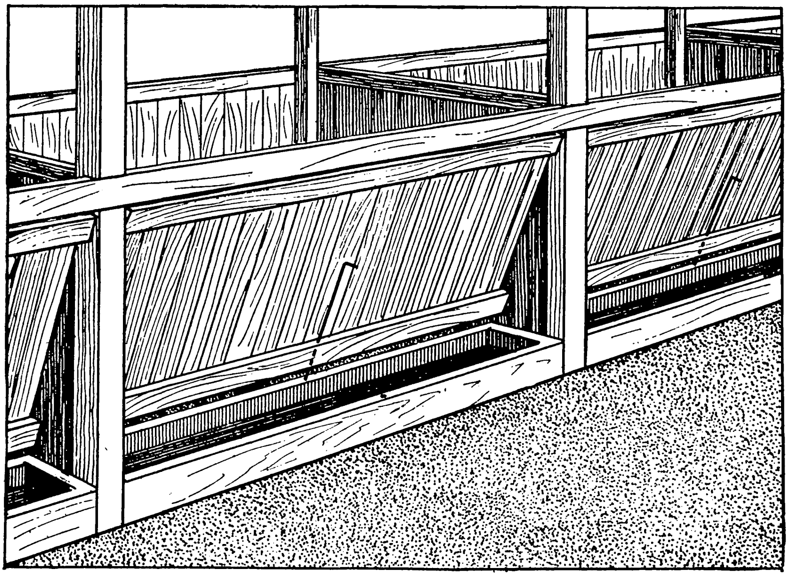

FIG. 16.—Pen with swinging front, open to allow filling of troughs.

It will generally be a satisfactory practice to keep hogs away from other stock, except when following fattening steers. Pregnant brood sows should never be allowed to run in the same yards or pastures with cattle, horses, or mules. Many good sows have been ruined by the playfulness or viciousness of the larger farm animals.

The pen and yard for the boar should be separate from the rest of the herd and out of sight of it. The pen should be so strong that the boar can not tear it down or go through it, and a tightly fenced pasture of one-half to 1 acre in area should adjoin.

A "down" [a] pigging sow, if she is to farrow in the piggery, can have the run of the alley for exercise. If she has a house to herself, a small yard should adjoin.

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[a] A sow about to farrow.

FENCING.

No man should attempt to raise hogs without adequate fencing of yards and pastures. An animal of any kind, but especially a hog, can make himself an intolerable nuisance if not confined within proper bounds. For pastures woven wire is the best fencing material, all things considered. Such a fence may be purchased ready-made or may be made on the farm by machines. There are several good kinds on the market. From motives of economy, it may be desired to run a fence of woven wire around a field to a height of 30 to 36 inches, and above this to stretch two or three strands of ordinary barb wire. This will make a hog-tight fence, and if horses are necessarily placed in the field the fence will be much safer than the ordinary one made entirely of barb wire. Midway between the posts the lower strand in the fence should be securely stapled to a small post or stake; this will prevent hogs from working their way under the fence. In building any kind of wire fence ground wires may be put down to moisture at frequent intervals to give stock protection from lightning.

A board fence makes, perhaps, the most secure inclosure for hogs, but its expense precludes its use generally except for yards and pens. These should always be of boards, stoutly nailed to strong, well-set posts.

Barb wire is very poor material for a hog fence. It can hardly be made close enough or strong enough to prevent a shoat from crawling through. In this respect it is only a little better than a hedge, which is expensive and unsatisfactory when used to confine stock. Gates must, of course, be carefully made, hung, and fastened.

PORTABLE FENCES AND HURDLES.

When hogs are run on annual forage crops, such as rape, rye, wheat, oats, or sorghum, temporary fences are almost absolutely necessary. They should be light, strong, and portable. A plan for such a fence

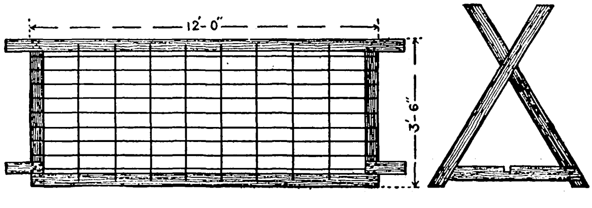

FIG. 17.—Wing's portable hog fence.

is seen in Figure. 17. It was designed by Mr. J. E. Wing, of Ohio.[a] Concerning this fence, Mr. Wing says:

Perhaps the combination of wire and wood will serve best; it is light, cheap, and if good wood be used, is durable. Get something that will not warp or twist. Hem-

[a] Breeder's Gazette, February 3, 1904.

lock will serve, and 1 by 6 inch stuff is heavy enough, though if it is to have much hard use, 2 by 6 inch will be better. The illustration [fig. 17] shows clearly how it is put together, with long nails clinching or bolts. Buy wire fencing, cut it into suitable lengths, leaving the ends long enough to pass clear around the end pieces and tie Tie the wire also to the horizontal pieces at intervals.

Except for special purposes it is better to buy woven-wire hog fencing, stretch it about the land to be pastured off, support it by stakes, and when through with it roll it up again and take it away.

Figure 18 shows a diagram of a hurdle which is very useful in catching hogs or driving them for short distances. This hurdle is made of 2½-inch stuff, 8 feet long, and the strips 3 inches apart, making the sections 30 inches high. Two sections of this size are hinged together. The hurdle is arranged with a hook and staple. A second hurdle may

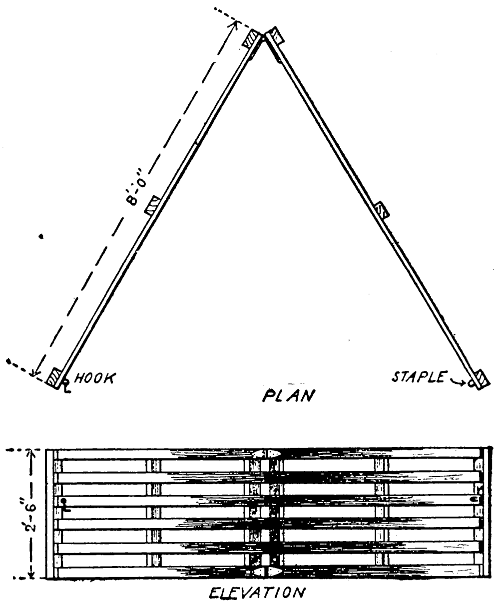

FIG. 18.—Hurdle.

be made, with hook and staple to correspond with this, and when hooked up, the two make an inclosure 8 feet square, which is very convenient for confining hogs for exhibition or sale.

THE FOUNDATION HERD.

SELECTING THE SOWS.

The first selection of breeding stock is of prime importance. The effects of mismating are always difficult to breed out of a herd, and the effect on a beginner is such that a mistake may completely discourage him. It is good economy to make haste slowly at this time. The start should be made with a few animals; five sows will make a

large enough herd for the first year. They should be good individuals, and it will even be much better to buy one high-class sow than five poor ones. This will be real economy, and the development of the herd will prove its value. It will be well if a beginner can obtain the assistance of an old and successful breeder in making a start.

The expression "the male is half the herd" is repeatedly quoted. So far as our knowledge of heredity has developed, other conditions being equal, there is uniform prepotency in both sexes; the influence of the two parents on the offspring is theoretically equal. Therefore, if the boar is half the herd, the sows certainly make up the other half, and their selection is a highly important matter. They may be purchased, already bred, some time before the boar, and quite an item of expense will thus be saved. Then by the time the sows have been watched and studied for a season and have each raised a litter of pigs, the owner will be much better prepared to select a suitable male, and he can then get one to use on both dams and offspring.

The sows selected should be nearly the same age, which should be about twelve months, and all should be safe in pig, preferably to the same boar. Their individual characteristics should, perhaps, be first looked to. While hogs do not show the strong differences of sex that we look for in a cow or a mare, sex characteristics always constitute a marked feature of a good brood sow. The smoother forehead and lighter, finer neck are points of distinction from the signs of masculinity in a boar. The forehead should be broad between the eyes, the throat clean and trim, the neck moderately thin, and the shoulders smooth and deep; the back should be fairly wide and straight, and ample room for the vital organs should be provided by a good width and depth of chest, well-sprung ribs, and straight, deep sides—a deep, capacious body from end to end. Depth of chest and abdomen are specially important in a brood sow. Pinched chests and waists must be avoided. It is generally advised that sows with much length of body should be selected for breeding purposes, length of body being regarded as an indication of fecundity. It will certainly do no harm to select sows that are especially long, but care should be taken that quality go with the increase in length. The loose-jointed, long-coupled, slow-maturing, and slow-fattening type should not be allowed to get a foothold in the herd. The influence of length of body on a sow's fecundity is by no means positively known. Many very short-bodied sows have proved to be wonderfully prolific breeders. The surest means by which to select prolific sows is to keep an accurate record of the herd and cull out all sows that do not yield a certain percentage of pigs annually. Each sow should have at least twelve well-developed teats, thus providing for the proper nourishment of large litters.

The important qualifications of the market hog should be looked for,

namely, smoothly covered shoulders, a wide, straight, deeply fleshed back, well-sprung ribs, straight, deep sides, broad rumps, and deep, well-rounded hams. A broad, well-developed pelvic cavity will generally insure a sow easy in parturition. The body should stand on moderately short, straight legs, with a moderate amount of bone. All hogs, particularly breeding animals, should stand well up on the toes. There is a tendency, more marked in some breeds than in others, for the pasterns to break down, so that the animal walks on the pastern bone instead of on the toes. This is particularly the case with the hind pasterns and is oftener noticed in boars than in sows. It is a weakness that seriously impairs the usefulness of the animal.

Brood sows should, of course, show quality, but this should not become overrefined and delicate. Extremes of refinement usually lead to delicacy of constitution and often accompany sterility.

As a last but very important point, these first sows should be uniform in type. Uniformity of type goes far beneath the surface. It includes every part of the internal organization. The reproductive system, the digestive system, the circulatory system, and even the nervous system influence uniformity. The breeder may often be disappointed in his results from sows that he thought were of a uniform type. His pigs are a heterogeneous lot, unpleasing to the eye, unsatisfactory in the feed lot, and profitless to the pocket. In such a case a lack of uniformity in the powers of heredity may no doubt be assigned as the cause of these unfortunate results. It must be borne in mind that it is comparatively easy to select sows that are uniform in quality, constitution, and conformation. This may be done by any skillful judge of hogs. But our only basis for the selection of animals uniform in reproductive powers and heredity of type is the breeding record of their sires and dams and the standard of the herds from which they come. For this reason it is readily apparent why it is an advantage for the beginner to select his sows from one well-established herd. Whether the sows will be uniform in breeding powers can only be determined definitely by testing them in the herd, but to select them from the same herd or from herds of similar breeding will be a reasonable guaranty of good results. When a sow has shown herself to be a prolific breeder she should be retained as long as her reproductive powers are maintained.

Uniformity in a herd is the surest index to the worth of the stock and the skill of the breeder, and its advantages are obvious. A uniform lot of pigs will feed better, look better when fattened, and command a higher price on the market than a mixed lot. With a bunch of sows closely conforming to the same standard, whose reproductive powers are similar, uniform pigs may be expected.

The importance of the male in the herd should not be asserted at the expense of the females, yet the importance of a male of marked

excellence must not be minimized. The boar represents 50 per cent of the reproductive power of the herd concentrated in one animal; the sows represent an equal amount of reproductive force, divided up among ten or twenty or fifty individuals. If, then, these females do not in their conformation and fecundity conform strictly to the same type, they are merely convenient machines for the birth and rearing of young—not what they might be, an influential force in furthering the plans of the breeder and raising the standard of the herd. It is not proposed to discuss at length in these pages the operation of the forces of prepotency as varying factors in breeding operations. The relative influence of one parent over another, the swamping of a weakly organized female influence by a strongly prepotent male factor, or vice versa, are interesting and important, but belong to the special study of heredity.

SELECTING THE BOAR.

If there is a tendency at times to exalt unduly the influence of the boar and neglect that of the sows, the beginner should not permit himself to reverse things and entirely neglect the boar. It was, indeed, the feeling that any male could be used so long as he had sufficient strength for service that brought about arguments in favor of the value of the boar. A breeder can not afford to neglect the animals of either sex. The male has, perhaps, the greater influence on the herd, for the simple reason that every pig in the herd is sired by him, whereas they have not all the same dam. To achieve the best results a breeder should never allow the standard of his sows to be lowered, and should always couple them with a boar of a little better grade. One thing must not be forgotten, and it indicates the chief difference between the influence of the two sexes in the herd: A superior boar may be used on a herd of inferior sows with good results, but the use of an inferior boar on sows of high quality will have a disastrous outcome. The one method raises the standard of the herd; the other inevitably lowers it.

A boar with the male characteristics strongly developed should be selected, preferably as a yearling or else as a pig that had been purchased at the same time as the sows and allowed to come to maturity before using. He should have a strongly masculine head and a well-crested neck. His shoulders should be developed according to age; but strong shoulder development in pigs under a year or eighteen months is objectionable. The same indications of a good pork-producing carcass that the sows required should be seen in the boar—a broad, straight, deeply fleshed back, much depth and length of side, and well-developed hind quarters. The boar should be selected to correct any defects that may be common to the sows; for example, if the sows are rather coarse in bone and loosely built, the boar should have

high quality—fine bone, skin, and hair. If the sows tend toward over-refinement and delicacy, the boar should be rather "rangy" and strong-boned. There is a common belief that the male parent influences principally the extremities and general appearance of the offspring, while the vital organs (the heart, lungs, and viscera) resemble those of the female parent. This theory is strongly questioned by some modern authorities on heredity; but so long as our knowledge of the subject is so limited and this particular phase is in dispute, it can do no harm to select breeding animals according to the old ideas. The visible organs of the reproductive system should be well developed and clearly defined. A boar should not be bought with small, indefinitely placed testicles. Avoid particularly a boar with only one testicle visible.

The boar should stand up on his toes. There should not be the slightest indication of weakness in the pasterns of a young one; in a mature boar (2 or 3 years of age) that has seen hard service it may be expected that he will be a little down on his pasterns, but a 6 or 8 months old pig that does not carry himself on upright pasterns is not a safe animal to select for a herd boar; the hind pastern will be in much danger of breaking down with a little age and service. Look carefully to the set of the hind legs. The back should be carefully set, straight, and closely coupled to hind quarters. A crooked or long-coupled back is as great a drawback as a weak pastern.

FEED AND MANAGEMENT.

The details of selection, feed, and management of live stock are intricately interwoven and interdependent. A man may be an excellent judge of stock, able to select those animals for his herd whose use will give the best results in breeding; but if his system of feeding and management is not such that the animals will thrive and yield a good increase, good selection is rendered ineffective. On the other hand, the herd may be carefully fed and skillfully managed, the feed may be the best and properly combined, the shelter warm and dry, and the water supply pure; but if the herd is poorly selected the owner is practically throwing away the feed he gives them.

The Sows.

Hogs require attention, regardless of condition, age, or sex, but the management of the brood sows is the surest test of the breeder's skill. If sows are carelessly fed during pregnancy, trouble of some kind is sure to ensue at farrowing; if overfed after farrowing, losses may occur among the pigs from scours and thumps. At no time is the development of the pigs so easily influenced as while they are dependent on the sow's milk—the first month of life. Excepting the ravages of epidemics, perhaps the greatest death losses in the herd occur dur-

ing this time, including farrowing. The accidents during farrowing, an attack of scours due to the milk of the dam, or a chill while following the sow in pasture on a wet day may stop growth temporarily, leaving a permanently stunted pig, or result fatally. On the other hand, the results of good management during pregnancy are as marked as the unfortunate consequences of careless methods.

MANAGEMENT DURING PREGNANCY.

It is assumed that sows that are bred are purchased as the foundation stock. If these sows are not all from the same herd they should not be placed together until they are all known to be free from vermin and contagious disease. They must be washed or dipped and quarantined from each other at least thirty days. If they come from the same herd no quarantine will be necessary.

It is always well for a purchaser to ascertain from the seller the details of management and feeding to which the animals were accustomed before changing owners. This system of feeding should be conformed to, or, if this is not possible, the old ration should be gradually replaced by the more convenient one, the time of transition being from ten days to two weeks. For the first few days newcomers should be fed lightly.

During pregnancy two facts must be borne in mind. The first is that the sow is doing double duty. Not only is she keeping up her own bodily functions, but the development of the fetal litter is a constantly increasing drain on her system. Although feeding at this time will not need to be so heavy as after the pigs are farrowed, it should be liberal. The sow's condition should be "good"—neither too fat nor too lean. An error which would allow the sow to become fat would perhaps be least productive of serious consequences. It is hardly too much to say that the mistakes in feeding breeding animals are more frequently those that keep such stock in a thin, half-starved condition, under the idea that the reproductive organs are so peculiarly liable to become transformed into masses of fat that the least appearance of fat on the animal's back and ribs will be the first step in bringing about such unfortunate circumstances. The use of the reproductive organs in either sex creates demands of an unusual nature on the animal organism, and these demands must be met in the same manner as those of a different character—such as growth, work, etc.—and that is by providing liberal supplies of the proper kinds of feed. It is beyond reason that a sow can give birth to a strong litter of pigs after having gone through a four months' fast. The importance of ample feeding of pregnant females, in the case of sheep, has been shown recently by Mumford[a] in Missouri. He found that during the first six to nine weeks of life those lambs having the

[a] Bul. No. 53, Missouri Expt. Sta.

heaviest birth weight made the greatest gains. The records of the gains of the lambs after weaning were not tabulated. As the develment of the fetus is intimately associated with the nutrition of the dam, it is urged that "we can profitably pay more attention to the development of the unborn lamb." Whether a similar fact may be true in the case of hogs is yet to be shown. It may not be unwise to assume that it may be so. Bad results undoubtedly may be brought about by overfeeding, especially as sows are naturally indolent and loath to exercise, but a counteracting influence will be found in ample exercise that may be provided by a large pasture or even by driving slowly a mile or two each day. The necessity of exercise must not under any circumstances be overlooked.

It must be remembered, in the second place, that the main demands upon the sow are those for the building of new tissue. Hence the kind of feed is important. The amount of nitrogenous, or protein-bearing, feeds in the ration at this time should be increased. These are bran, pease, beans, oats, and barley, and, to a moderate extent, wheat. The forage plants that are especially suitable to pregnant brood sows are the clovers and their relatives—alfalfa, peas, beans, vetches, etc. The ordinary pasture grasses are also of much value. Feed should be given in such form that the system of the sow will be at its best. All breeders lay special emphasis on the condition of the bowels during pregnancy, and particularly at farrowing, the special danger to be avoided being constipation. To this end the greater part, if not all, of the grain ration is given as slop, and toward the close of the period of gestation oil meal or a small amount of flaxseed meal is introduced into the ration.

Corn should not be fed in large amounts to breeding stock. If possible, it should not be fed at all to any but fattening animals. In the corn belt many farmers are often so situated that they have no other grain feed at hand. If corn must make up the greater part of the ration of the brood sow, the injurious effects may be counteracted in a measure by compelling the sows to exercise. Various schemes may be necessary to bring about this result, such as having the house and feeding floor or the feeding floor and watering place at opposite ends of the hog lot; so that a good walk is a necessity several times each day. If the lot is located on a hillside, the walk is made a climb. Some men scatter grain among straw and corn fodder with this idea of exercise in mind, and others resort to the whip and drive the sows gently for a mile or two each day.

During the winter more care will be needed to keep the sow in good health on account of the absence of pasture. Not only does the hog's system crave green feed, but more or less bulk is demanded. This is especially needed when a considerable amount of confinement is necessary. To offset the lack of green feed nothing surpasses roots.

These may be sliced or pulped and mixed with the grain or may be given whole, as a noon feed. Some care must be used in feeding roots, as they are laxative in effect, and if fed in excessive amounts may bring about profuse action of the bowels. Some Eastern farmers recommend the use of silage. If neither is available, clover or alfalfa hay, sheaf oats, or corn fodder may supply the bulky requirement of the ration with good results. Charcoal, ashes, and salt should be accessible at all times. These act as a vermifuge and preventive of disease and meet the hog's craving for mineral matter in the feed. The Bureau of Animal Industry formula is found on another page in this article. (See p. 257.) The constant use of such a preparation with a varied and not too carbonaceous ration and care in removing the afterbirth will, in large measure, prevent sows from eating their pigs at farrowing time. During the entire period care should be taken to keep the system well toned. The sow should become accustomed to being handled, and should look upon her attendant as a friend.

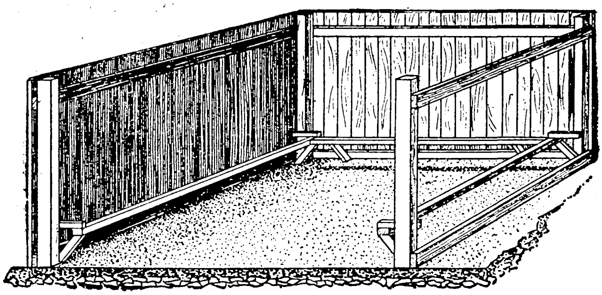

FIG. 19.—Farrowing pen with fenders.

All the brood sows may run together up to within two weeks of farrowing time; then it is well to separate them, placing each sow by herself in a yard with a small house, such as has been described, which should be dry, airy, and clean. A great deal of exercise will not now be necessary. The feed should be reduced somewhat, and if there is any tendency to constipation a slight change of feed may be necessary. If individual houses are not available, sows can not be separated until near farrowing time.

The farrowing pen should be provided with fenders around at least three sides about 6 or 8 inches from the floor and 6 or 8 inches from the wall. These should be strong enough to support the weight of the sow should she lie on them. They will, to a great extent, protect the pigs from being lain upon during the first few days of their lives. This will go far to prevent a very fruitful cause of loss among young pigs. The little fellows will soon learn to creep under these fenders when the sow lies down. Figure 19 shows a farrowing pen with fenders made of 2 by 4 scantling fastened around the walls,

Many breeders now use a specially arranged farrowing pen for sows, the object being to allow the sow room enough to farrow with reasonable comfort, but not enough to turn around. The safety of the pigs under such circumstances is said to be much greater than when the sow is given all the space she cares to take. Provision is made for the safety of the pigs by raising the walls of the pen 6 or 8 inches from the floor. Such a pen may be readily arranged by placing the sow at one end of her pen and nailing boards across so that she can not turn, leaving space for the pigs to slip under the barrier. A number of patented farrowing pens are on the market.

FARROWING TIME.

Sows vary little in the period of gestation. This period is about one hundred and twelve days from the date of breeding. This date should be known, to avoid mistakes that may result in loss of pigs. As the time for farrowing approaches the sow should be watched carefully, in order that assistance may be given, if necessary. If she has already farrowed a litter, and has been properly fed and cared for during pregnancy, little difficulty may be expected. With young sows, particularly those bred at an immature age, there is a considerable element of risk at this time not only to the pigs, but to the sow herself.

The bedding of a sow at farrowing time should be sufficient only for cleanliness and dryness. If furnished in large amount, the pigs will burrow into it and get lost or be crushed. The best bedding is rye straw and wheat straw, and if the straw is cut it makes an almost ideal bed. Chaff is excellent if it can be obtained. Oat straw is not so valuable.

The management of sows during farrowing will depend largely on the animal and on the weather conditions. Assistance should be at hand if needed, but the sow should not be helped if she is getting along nicely alone. Many pigs are lost annually by lack of attention during farrowing; but, on the other hand, there is no doubt that in many cases overanxiety and too much attention may do more harm than good and often result seriously. The assistance that is imperative at this time is to help in cases of difficult labor and to protect pigs from chilling in cold weather. The temperament of the sow should be considered; some are plainly annoyed by the presence of an attendant and show it in their nervous actions; others may be positively ill natured and resent interference. Such sows are better left alone during farrowing, and should be bred to farrow when warm weather may be expected, so that the chances are as much in favor of the pigs as possible. If the sow's nervousness or ill nature leads her to eat her pigs, the best remedy is to put her in the pork barrel at the earliest opportunity.

When farrowing occurs during warm weather, a minimum amount

of attention will be needed. The pigs are less likely to become chilled at this season and will generally find their way to the teats unaided. Proper preliminary feeding of the sow and good quarters will make the chance of trouble small. On the other hand, if a sow farrows during extremely cold weather the pigs will be in danger of being chilled unless the house is heated. To remedy this some breeders throw a blanket over the sow until she is through. Others place a few hot bricks or a soapstone in the bottom of a basket or barrel, covering them with straw, and put a cloth over the top to prevent too rapid radiation; and, unless the sow objects too seriously, the pigs are placed in this receptacle as fast as they arrive. They will not suffer if they do not suck for a few minutes, and they will be dry and warm when placed to the teats. This treatment will be necessary even in warm weather with sows that are nervous and move about during farrowing. When farrowing is over the pigs should all be placed to the teats, care being taken that each one gets his share. When the afterbirth is passed it should be removed at once and burned or buried. There is good reason to believe that the eating of the afterbirth is often the beginning of the habit of eating the pigs that is so troublesome with some sows.

In very cold weather it may be necessary for a few days to remove the pigs to a warm place after they have sucked, to prevent chilling. As newborn pigs suckle as often as every two hours during the day, this entails considerable inconvenience; but it is time well spent and may mean the difference between profit and loss to the breeder. The pigs are soon able to fight their battles with the cold unaided by any but their own warmth and that of the dam.

For the first twenty-four hours the sow should, as a rule, have no feed, and will need none. If, however, she shows signs of hunger, a thin slop of bran and shorts or a thin oatmeal gruel may be given. Tepid water should be given to drink as the sow wants it. Never give cold water.

The feeding for the first three or four days should be light and carefully given, and the time consumed in getting the sow on full feed should be from a week to ten days, depending on the size and thrift of the litter. The first feed should be very light, and in the form of a thin, warm slop, such as is mentioned in the preceding paragraph, working gradually to full feed. The pen should be cleaned daily if the sow is confined to it.

The Sow as a Mother.

No time should be lost after farrowing in getting the sow into the open air. Of course, if the pigs were farrowed during the winter months care will be needed, and it may be necessary to let the pigs reach the age of two weeks before turning them out. They can, how-

ever, get considerable exercise in the piggery or in the lot with the sow, and there is often a lot adjoining a barn that is sunny and sheltered from cold winds where the new family may be turned for exercise. Avoid particularly allowing the pigs to run out during a cold rain. They are especially tender during the first weeks.

The appetite for something besides the dam's milk may begin to assert itself by the time the pigs reach three weeks of age. This time will vary, of course, some pigs being more precocious than others. They will be noticed nibbling at grass, rooting a little, and even investigating the sow's feed. A pen should be arranged adjoining that of the dam and separated from it by a partition, with sufficient room at the bottom to allow the pigs to run under. Figure 20 shows a pen arranged with the partition between it and the dam's pen raised. In this inclosure put a low, shallow trough and place in it a little skim milk or a thin gruel similar to that recommended for the sow the first day after farrowing. This gruel may be made with any concen-

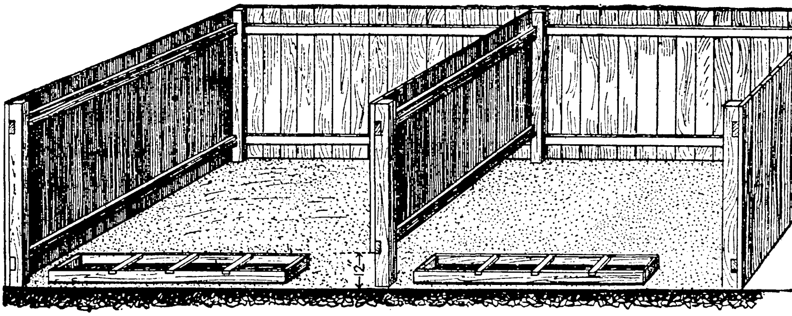

FIG. 20.—Double pen for feeding suckling pigs; partition raised to permit pigs to run to their feed without interference from the sow.

trate that is free from woody matter. If ground barley or oats is fed, the meal should be first sifted to remove the hulls. There is a great variety of feeding stuffs that can be used. The main point to be observed is that the pig's stomach is very easily deranged at this age and feeds must be given that will digest readily. The trough in which the pigs are fed should be kept clean. No stale feed should be allowed to remain in it from one feed to the next.

As the pigs learn to eat the feed may be increased. Skim milk should be used liberally, using rather large quantities at first, from 6 to 12 pounds of milk to each pound of grain. During this period comparatively little corn should be fed, as a rule. More growth can be obtained with a narrow ration, and the corn should be withheld until the fattening period comes. The pigs should be kept growing constantly, and the best results will come with feeding a little under their capacity rather than all they can consume. To counteract the tendency to become too fat they should have plenty of exercise.

Scours and thumps often cause very serious losses among young pigs. The former is caused usually by overfeeding, by feeding badly spoiled feed, by an abrupt change of feed, or by a change in the feed of the dam that affects her milk. Thumps is generally caused by overfeeding and lack of exercise.

Weaning.

If the pigs have been properly managed for the month after they first begin to eat, and are taking feed in amounts sufficient to make them more or less independent of the sow's milk, weaning will not be a difficult process, and will be brought about so that it will be scarcely perceptible, so far as the effects on the pigs are concerned. The time to wean will depend on the way the pigs are eating and the convenience of the breeder. If they are not thoroughly accustomed to a grain and skim-milk ration the time must be delayed, and if there is no occasion for breeding the sow no harm is done by allowing the pigs to run with her to the age of twelve weeks or older.

Breeders differ widely as to the age of weaning. The majority wean at six to ten weeks, with a considerable number at twelve weeks; some older than twelve weeks and a few younger than six weeks. The breeders who wean at the early periods usually are situated where dairy by-products are plentiful, and they usually raise two litters each year, making the demands of the pigs on the sow as brief and light as possible. Breeders in the corn belt wean at the more mature ages, rarely weaning as young as six weeks, and often allowing the pigs to reach the age of sixteen weeks before the sow is taken away. A considerable number of men make no attempt to wean, as the word is generally used; that is, there is no enforced separation of the sow from her pigs; the pigs run with the sow until her instinct tells her that they are old enough to shift for themselves.

The method of weaning will depend somewhat on circumstances. If the pigs are so little dependent on the sow's milk that she is gaining rapidly in flesh and lessening in milk flow the weaning may be abrupt, the sow being taken away out of hearing. If she is still milking considerably she may be returned to the pigs once a day for two or three days, or the pigs may be taken away in detachments, beginning with two or three of the largest and strongest, then the next strongest, leaving the weakest ones of the litter to complete the drying off.

Whether the weaning is brought about directly or gradually, it should in all cases be complete and decisive. The pigs should be placed apart from the sows in quarters secure enough to prevent communication. By no means should pigs be allowed to follow a sow until she is almost worn-out. The pigs are no better and the sow infinitely worse than if weaning had been brought about properly.

Feeding the Pigs.

Attention will now be given to the pigs that have been weaned. Up to this time all are on the same feed and under the same management. From now on, however, those that are to be retained as breeding animals should be continued on a growing ration—that is, one which is somewhat narrow and will develop bone and muscle to the largest extent. Those that are to be fattened for market should be fed more liberally and their feed made more carbonaceous.

The Breeding Stock.

The foundation on which to build up a successful breeding animal is ample range, affording an abundance of exercise, and a rather narrow ration. Growth should he continuous and feed plentiful. The pigs should not be given range so large and so little feed that they will develop nothing but bone; neither should they have so much to eat that they will become indolent and refuse to take the exercise required to develop necessary bone and muscle. Exercise will strengthen the sinews and develop strong muscles, as well as firm joints and strong legs, while a well-filled stomach will nourish these; and from this management we may expect a sow that will be strong, thrifty, and a good breeder, and a boar that will do good work in the herd without breaking down in any respect before he should.

Gilts should not be served before the age of eight months, bringing the first litter at twelve months. This gives sufficient time for the development of the reproductive organs.

Selecting for Fattening.

As soon as it is determined what pigs are to be fed for market their fattening should be started without delay. Experiments have repeatedly proved that young animals always fatten more economically than old ones, and therefore any delay in finishing is accompanied with a loss. In rare instances it may pay to keep a pig over winter as a "store" hog, but generally he loses the flesh he accumulated while suckling his dam, and this can not be replaced except at increased expense. Corn will now come into the ration, and should be supplemented by all the variety of feed at the feeder's command, to keep the appetite keen and the digestive system in the best condition. This variety should consist of mill feeds, dairy by-products, and succulent feeds, and, according to some authorities, pasture. If skim milk, whey, and buttermilk are at command they can be combined to very good advantage with the ration, commencing with a proportion of about 2 pounds of milk to 1 of grain at weaning time, and reducing the quantity of milk until the pigs are finished on grain alone. A pig gives best returns from dairy by-products while young. The fattening pigs should gain from 1 pound to 1½ pounds daily, and should weigh

between 250 and 300 pounds at 9 or 10 months of age. Gains made after this weight are nearly twice as expensive as those made when weighing from 50 to 100 pounds, and a well-bred pig finished at a weight of about 250 pounds will very nearly fill the market requirements and bring a satisfactory price.

Selection of Breeding Stock.

The pigs which are to be used for breeding purposes should be selected during the time when the pigs are with the sow. If he is raising hogs for market a breeder will select only sows, castrating all boars. No boar should be used or sold that is not eligible to registry. If the breeder is raising purebred stock the inferior boars will be culled out and castrated, the others being kept for the breeding market.

The selections should be made as early as possible, depending on the skill of the breeder. That noted feeder, the late Mr. William Watson, used to select his show lambs and calves not later than three days of age. He said an animal had all the development of heart and rib at that age that he would ever get, and his results in the show ring bear out the accuracy of his judgment. However, all are not endowed with the keen insight into animal form that Watson possessed. A selection for a breeding animal should not be made unless there are good and sufficient reasons for it, and unless the breeder is quite sure he is right in making the selection. The sows selected should be from large litters and from dams that are good milkers, and of quiet, motherly dispositions.

Castrating and Spaying.

The boar pigs should be castrated during cool weather, as soon as the testicles descend into the scrotum. An early date is always preferable to a late one, for the development of sex characteristics is of no value to an animal that is intended for meat.

The practice of spaying sows is not very general. It is much more difficult than castration. It often happens that sows may become pregnant before spaying and bear a good litter of pigs after that operation.

Management of the Dry Sows.

After the pigs are weaned the dry sows should be placed in a pasture by themselves and given very little grain. Those that show themselves to be prolific and good mothers should be retained as breeders; those having a deficient breeding record or being unsatisfactory in any way should be fattened and sold as soon as possible. It does not pay to keep over a year a sow that can not raise a large litter, unless she is purebred and a very exceptional individual.

If a second litter is wanted during a year the sows should be put to

the boar during the first heat after weaning. Many breeders do not like to pass many periods of heat for fear that the sows may become "shy," and there is little reason why the sow should not have two litters a year. In any case, the sows should be carried on comparatively light feed until time to breed again, gaining a little in weight; and their treatment after breeding should be as already detailed for pregnant sows.

The use of a breeding crate (fig. 21) is growing in popularity. When a small sow is to be bred to a large, heavy boar it is almost a necessity; its use prevents injury to the sow. Some sows, although in heat, will not take the boar readily, and the use of a crate in these cases insures a successful service. Many breeders use a crate for all their sows.

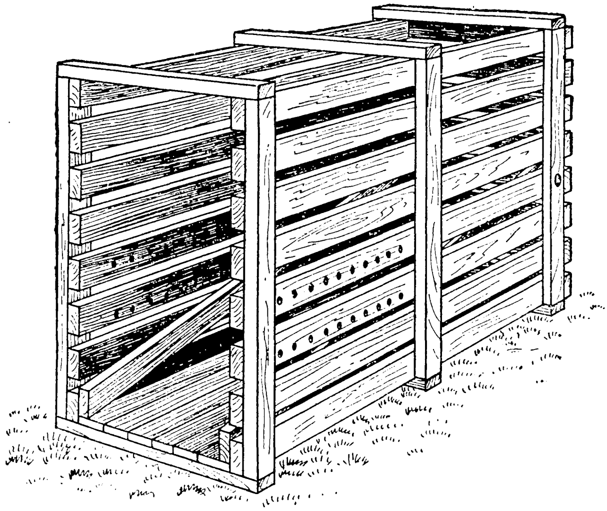

Fig. 21.—Breeding crate.

Such an appliance may be made by any carpenter. All that is necessary is a stout frame, made of 2 by 4 inch scantlings, closed in front but open behind, a bar to slip behind the sow just above the hocks, and a 2 by 4 inch strip attached at the forward end of the crate on either side, about the position of the sow's head and extending to the rear of the crate, where it is fastened to the bottom of the crate. The boar's fore feet will rest on these strips.

Management of the Boar.

The management of the boar has been left until this place in the discussion, not because it is an unimportant subject, but because the sows occupy by far the greatest amount of the breeder's attention; and also because it was assumed at the outset of this discussion that the work of a beginner, with only a group of brood sows, was being outlined.

When the boar arrives at the farm he should be dipped, as a matter of ordinary precaution, against the introduction of vermin. As an additional precaution, a quarantine pen should be ready for him, especially if epidemics are prevalent. In short, he should be treated in much the same manner as has been prescribed for the sows. His feed before change of owners should be known, and either adhered to or changed gradually to suit the new conditions. If he shall have come a long journey it will be well to feed lightly until he is well acclimated.

His permanent quarters should be a clean, dry, warm, well-lighted, and well-ventilated pen, 10 or 12 feet square, with a yard adjoining where sows may be brought for service. This yard should be large enough to give him some exercise during the breeding season, when it may be inconvenient to allow him the run of a pasture. Adjoining the yard should be the boar's pasture, from one-half acre to an acre in extent, consisting of clover, alfalfa, or good pasture grasses that thrive in the locality.

Breeders generally advocate the practice of keeping a boar to himself during the entire year—out of sight and hearing of the sows. However, a boar is often allowed to run with the sows after they are safe in pig; but during the breeding season it is by far the best policy to keep him by himself, admitting a sow to his yard for mating, and allowing but one service. This will be productive of the best results in many ways. The energies of the male are not overtaxed. He may thus serve a much larger number of sows, and the litters will generally be larger and the pigs stronger. In the case of a sow that is a somewhat shy breeder and a valuable animal she may be allowed to remain with a boar during the greater part of her heat, but such instances are exceptional. Another advantage of the single-service system is that a man always has an accurate knowledge of his breeding operations and knows when to expect farrowing time.

The feed of the boar when not in service may be of a succulent nature—mainly pasture and cut green forage during the summer months and roots in winter. A boar can hardly be sustained on this alone, and some grain should be allowed to keep him in condition. This should be nitrogenous in character, consisting of mill feeds—such as shorts, middlings, and bran—some oil meal, and the leguminous grains, with a little corn. As the breeding season approaches the feed should be increased, so that the boar will be in good condition. While not in service ample exercise should always be insisted upon, even if it must be urged by the whip. Exercise is productive of well-developed muscles and general thrift; with these two conditions activity and soundness of reproductive organs will usually follow. During the breeding season it will not be possible for the boar to get the same amount of exercise, and accordingly care must be taken that his energies are not wasted by unnecessary service. Care-

ful feeding will do much to counteract this disadvantage. It must always be remembered that the drains on a boar during service are severe, especially if 50 or 60 sows are served. This will require ample feed, with as much exercise as possible, and, with care in his treatment, will bring about good results. A fully matured boar should not serve more than 2 sows daily, preferably one in the morning and one in the afternoon, and can serve 50 or 60 in a season without difficulty.

Coburn[a] advises that where farmers own but 12 or 15 sows each, three or four breeders might purchase a boar and use him in common, thus saving materially in expense. Cownie[b] states that he has found it well to have at least two boars in the herd, even though the herd be small in numbers.

SANITATION IN THE HOG LOT.

The greatest drawback to the hog industry which breeders in this country have to contend against is the presence of highly contagious diseases known as "hog cholera" and "swine plague," or, popularly, as "cholera," and were it not for the fecundity of these animals their profitable production would be out of the question. These two diseases are so closely identical that postmortem examinations are usually required to distinguish between them. Indeed, only recently (on October 1, 1903) de Schweinitz and Dorset, of the Bureau of Animal Industry, announced the discovery of a fatal disease of swine which is caused neither by the hog-cholera nor swine-plague bacilli, and which is apparently a very frequent cause of swine fatalities.

For the present the breeder can regard these diseases as identical, so far as his practical management of the herd is concerned.

There are a few fundamental facts which he must remember if he is to avoid losses by reason of the presence of hog cholera or swine plague in the herd. The first is that they are specific germ diseases, disseminated by bacteria, and the contagion can not be spread from one animal to another or from one herd to another except by these minute organisms. They may be carried in a multitude of ways—by the hogs themselves, on the clothing of persons, on vehicles, in feed, by dogs, birds, and other animals, or by streams. The breeding or feed of a hog can not cause either disease, although bad methods may so weaken constitution and vitality that the animal becomes more susceptible than would otherwise be the case. Second, diseases caused by bacteria may be prevented in large part by thorough disinfection. Third, bacteria are generally preserved in filth, and, therefore, scrupulous cleanliness will go far toward preventing outbreaks of disease in herds of hogs.

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[a] Swine Husbandry, pp. 93, 94.

[b] Kansas State Board of Agriculture, Thirteenth Biennial Report, p. 693.

PREVENTION OF DISEASE.

Cleanliness.—Preventive measures must be most relied upon. Hogs must be given dry and well-ventilated quarters, which must be kept clean. Contrary to common belief, hogs have some habits which raise them above other domestic animals from the standpoint of cleanliness. For example, unless compelled to do so, a hog will not sleep in its own filth. If part of the floor of the pen is raised and kept well bedded with straw, while the rest is not, all excrement will be left on the unbedded portion of the floor, and the bed itself will always be clean.

Feeding and drinking places should be clean and the water supply pure. Unless the origin is known to be uncontaminated and there has been no possibility of infection during the course, hogs should not be allowed access to streams. Wallows should be kept filled up as much as possible. At least once a month the quarters should be disinfected with air-slaked lime or a 5 per cent solution of crude carbolic acid. If a hog dies from any cause, the carcass should be burned or buried and the pens thoroughly disinfected at once.

Breeding and feeding.—While inbreeding is the surest and quickest means to fix type, the system weakens vitality unless very carefully followed. For this reason closely inbred hogs are more susceptible to cholera than those whose constitutions have not been impaired by the system. The straight corn diet which many hogs receive from one year's end to the other also lessens vitality, and the researches of the Wisconsin Experiment Station have shown that this is probably brought about by actually retarding the development of the vital organs. A minimum of inbreeding and a varied diet, including, especially for breeding stock, ample range, will therefore better enable the herd to resist the attacks of disease.

Isolated houses.—The advantage of a number of small portable houses, each accommodating a few hogs, rather than one large piggery for the entire herd, has been referred to in the foregoing pages. In districts where cholera is prevalent these are undoubtedly the best shelters. They make it more difficult to carry contagion to all animals in the herd, and the destruction of one of them in case of an outbreak does not entail a great expense. An added advantage is that they may be moved from place to place as needed. While more work is necessary in feeding, the convenience and safety from their use more than offsets this disadvantage.

Quarantine.—Whenever new animals are brought to the farm, or when animals are brought home from shows or from neighboring herds, they should be kept apart from the rest of the herd for at least three weeks. If they have been exposed, the disease will manifest itself within this time, and the sick animals can be treated or killed and disposed of at once.

If cholera breaks out in the neighborhood the farmer should maintain a strict quarantine against the infected herds. He should refrain from visits to farms where they are located, and should insist on his neighbors staying out of his hog lots. Intercourse of all kinds at this time should be carefully restricted. The contagion is so easily carried that the strictest measures are justifiable.

TREATMENT OF DISEASES.

As soon as sickness appears in the herd the unaffected hogs should at once be removed to clean, disinfected quarters, preferably without much range, for by running over pastures they may come in contact with contagion. Their feed should be carefully regulated, and, if they have previously been on pasture, should include some green feed, roots, or an abundance of skim milk.

The quarters in which the sickness first appeared should be thoroughly cleaned, all bedding and rubbish burned, and loose boards and old partitions torn out and burned. If the pen is old, knock it to pieces and burn it. Disinfect pens and sleeping places, using air-slaked lime on the floors and the carbolic-acid solution on the walls and ceilings. Whitewash everything. If a hog dies, burn the carcass or bury it deeply out of the reach of crows, buzzards, or dogs. If possible, do not move the carcass from the place where it falls; but if this can not be done the ground over which it is dragged should be disinfected. Hog-cholera bacilli can live in the ground for at least three months. Care must be taken to maintain an absolute quarantine between the sick and well hogs. The same attendant should not care for both lots unless he disinfects himself thoroughly after each visit to the infected hogs. Dogs should be confined until the disease is stamped out.

Treatment of hogs suffering from cholera or swine plague is not always satisfactory. The disease runs its course so rapidly that curative measures are more or less ineffectual, and prevention of an outbreak should be relied upon rather than the cure of sick animals. Salmon[a] states that the following formula has been successful when properly administered in less virulent outbreaks as soon as signs of sickness are shown:

	Pounds.
Wood charcoal	1
Sulphur	1
Sodium chlorid	2
Sodium bicarbonate	2
Sodium hyposulphite	2
Sodium sulphate	1
Antimony sulphid (black antimony)	1

[a] Farmers' Bul. No. 24, Dept. Agr.

"These ingredients should be completely pulverized and thoroughly mixed. In case there is profuse diarrhea the sulphate of sodium may be omitted."[a]

A large tablespoonful once a day for each 200 pounds of live weight of hogs to be treated is a dose. The medicine should be thoroughly mixed with the feed, which should be soft, made of bran and middlings, corn meal and middlings, corn meal and ground and sifted oats, or crushed wheat, mixed with hot water. If the hogs are too sick to come to the feed, they should be drenched by pulling the cheek away from the teeth and pouring the medicine in slowly. Care should be exercised, as hogs are easily suffocated by drenching. Do not turn a hog on its back to drench it.[b]

PREVENTION AND DESTRUCTION OF VERMIN.

Hogs often suffer very much from vermin. Lice are introduced from neighboring herds, and the losses in feeding are often severe, especially among young pigs, when death is sometimes a secondary if not an immediate result. When very numerous, lice are a very serious drain on vitality, fattening is prevented, and in case of exposure to disease the lousy hogs are much more liable to contract and succumb to it.

Vermin are most common around the ears, inside the legs, and in the folds of the skin on the jowl, sides, and flanks. In light and isolated cases they may be destroyed by washing the hogs. In severe cases, however, especially where the whole herd is affected, thorough spraying or dipping should be resorted to. In this case a dipping tank will be a great convenience.

Figure 22 shows the ground plan and side elevation of the pig-dipping plant suggested by the Nebraska Experiment Station.[c] The details of construction may be understood from the drawings. The approach from the yard to the slide is cleated and elevated, at the inner end, 1 foot 6 inches above the ground. The slide is covered with zinc or galvanized iron, and with this pitch is very slippery when wet. The zinc which covers the slide is lipped over the edge of the tank to prevent waste of the dip. The tank is placed in the ground with its edges even with the surface. A galvanized tank is suggested; it can be easily made by a tinner. The size of the tank will depend on the number of hogs to be dipped. The one in the drawing is 4 feet deep, 10 feet long at the top, 5 feet long at the bottom, 20 inches wide at the top, and 8 inches wide at the bottom. The sloping surface of the tank should be cleated or fluted to enable the hogs to get out easily. The dripping pen is raised 1 foot 6 inches at the outer end and is cleated. The cleats are laid at an angle with the sides of the pen and arranged in pairs, with a space

[a] Farmers' Bul. No. 24, Dept. Agr. [b] Idem. [c] Bul. No. 74.

between them so that the dip may drain back into the tank. Provision must be made for the displacement of fluid by means of tongued-and-grooved boards fastened to the sides of the vat.

One of the most effective and cheapest preparations to use as a dip is a 2 per cent solution of creolin. The common tobacco dips used for sheep scab are also efficacious. If the hogs are washed, apply the solution with a broom; if they are sprayed, use an ordinary spray pump; for dipping, use a dipping tank. When being washed or sprayed the hogs should stand on a tight board floor.

Newly purchased hogs should be carefully examined for vermin, and they should not be turned with the herd until they are known to be free from these pests.

When the herd is found to be badly infested with lice all bedding should be burned and loose floors and partitions torn out. Old boards and rubbish should be burned. The quarters should then be

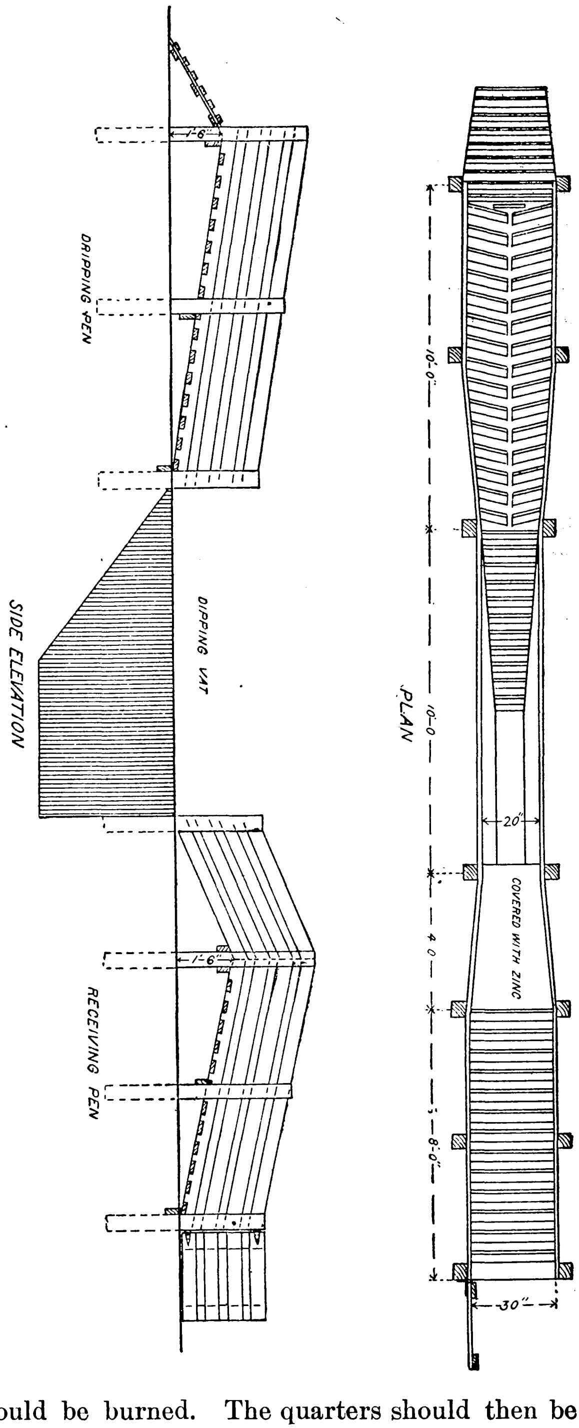

Fig. 22.—Dipping plant.

thoroughly disinfected by spraying with one of the solutions mentioned. (The creolin solution is good.) After disinfection, as in the case of a disease outbreak, everything about the place, inside and out, should be thoroughly whitewashed.

In these remarks on sanitation no attempt has been made to go into the details of the diseases affecting hogs or their treatment. They are simply intended to call attention to the simple measures which may be used by any farmer to avoid, to a large extent, the decimation of his herd by epidemics. Cleanliness and rational methods of management are relied upon by thousands of farmers to keep their herds in health and vigor. They are the marks of the good farmer and successful hog breeder.

A REVIEW OF SOME EXPERIMENTAL WORK IN PIG FEEDING.

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FEATURES OF EXPERIMENTAL WORK.

In the following pages will be found brief abstracts of some of the more important experimental work in pork production during recent years. The subject was presented in more complete form in Bulletin No. 47 of the Bureau of Animal Industry.

In studying the results of experimental work it is important to bear in mind that different conditions influence strongly the work of different stations. At the conference of animal husbandry workers in Chicago during the International Live Stock Exposition of 1902, Prof. W. A. Henry called attention to this fact. He pointed out that an "average," to be of any scientific value, should summarize work conducted with all conditions—such as age of animals, breeding, kinds of feed, care, management, and season of the year—as uniform as possible, and should represent the results of the labor of one man conducted at the same station and extending over a very considerable term of years. These factors are all of the highest importance and it is essential that they be considered in studying results. Good feeders know that animals of different ages feed differently, that breed is often an influential factor, that all feeds do not have the same value in the ration, and that good shelter and regular and skillful feeding are highly essential to secure profitable results. It is also readily apparent that, if all other conditions are equal, an experiment conducted in Maine to compare the value of corn meal with that of whole shelled corn can not be averaged, but only compared, with one of a similar nature conducted in Iowa or Oregon; the factor of climate is important and influential. The results of an experiment with hogs fed in the summer months are not to be averaged with those obtained with similar animals under exactly similar conditions of feed, care, and management during the winter. Even where all conditions are similar and every care has been taken to make them as uniform as possible, seasonal variations of climate may inject another factor of error. The results of two experiments conducted by a corn-belt station, the one during 1901, the other in 1902, could not be averaged with pro-

priety, although they were conducted as uniformly as possible, because the year of 1901 in the Central West was one of drought and the summer exceptionally long and hot; whereas weather conditions were exactly the reverse during 1902, when an unusual amount of rainfall was recorded, with very low temperatures during the summer.

If the farmer will bear in mind the influence of these modifying conditions, he can better realize the difficulties that surround experimental feeding; he will better understand their value, and will find himself listening more carefully to the advice of experiment station workers, reading bulletins with more confidence, and condemning less hastily what seems to be inaccurate. If each farmer regarded himself, in a way, as an experimentalist and should spend a small amount of time in keeping records of his operations, studying the results with the aid of the information at his command, and if he should at the same time keep in touch with the authorities of his experiment station, there is little doubt that many of the problems now perplexing farmers would be brought much nearer to a solution and the business of feeding live stock rendered more systematic and profitable.

PRINCIPLES OF FEEDING.

PHYSICAL CHARACTER OF FEEDS.

Feeds, as regards their physical characteristics, are generally divided into two classes; namely, concentrated feeds, or concentrates, and bulky feeds, commonly called coarse fodder, roughage, or forage. The seeds of plants, whole or ground, and all such feeds as are produced from the by-products of commercial establishments (mills, packing houses, etc.) supply a large amount of nutriment in small bulk, and hence are called concentrates. The body of plants, in the form of hay of all kinds, straw, green fodder, pasture grasses, and roots and tubers, gives us bulky feed or roughage. Vegetables, such as pumpkins, and the waste fruit of orchards are often fed to animals and are in the category of bulky feeds. All of these supply a relatively small amount of nutriment and a large amount of feed material. Milk is, properly speaking, a bulky feed when fed to rather mature animals, particularly when skimmed. For young animals whole milk is the most "complete" feed known, but it is too expensive to feed any but the youngest animals or those that are to be brought to the highest condition in the shortest possible time.

RELATION OF BULKY FEED TO LENGTH OF ALIMENTARY CANAL.

The amount of bulky feed required is different with different species of animals and depends upon the complexity of the feed of the animal; and the kind and variety of feed, in turn, have a direct relation to the length and complexity of the alimentary canal. For example, in a

state of nature carnivorous animals, such as those of the cat and wolf tribe, have very short and simple alimentary canals and live upon flesh, which is a very simple diet. Herbivorous animals—that is, those that subsist exclusively upon grasses, browse, etc., such as the horse, ox, sheep, and goat—have the most complicated digestive apparatus and eat a very great variety of feeds. Between these two classes we have those animals that live both on a flesh and a vegetable diet, and with them the alimentary canal is longer and more complicated than that of the carnivora, but shorter and less complicated than that of the herbivora. The pig belongs to this class, which is denominated the omnivora. Domestication has changed the habits of animals considerably, and in so doing has changed the internal characteristics of the body. Domestic dogs and cats have been brought to subsist on a diet in which there is a rather large amount of vegetable matter. Pigs are fed almost exclusively on a vegetable diet and only occasionally indulge their appetite for an animal diet. As a consequence of this variation in the range of feed eaten in domestication these animals have a longer and more complicated digestive tract than the same species in the wild state.

FUNCTION OF BULK IN THE FEED.

The function of bulk in the feed is more than the mere furnishing of nutriment, for, in a mechanical way, it aids digestion. In the ruminant animals especially there is an enormous stomach content which must be comfortably filled if digestion is to be carried on properly. Hence, with this class of animals a great amount of hay, etc., is required, and they can also give the best returns from a bulky feed and subsist more satisfactorily than any others on hay or straw alone. Pigs require less bulky feed than other domestic animals, but recent experiments show that, to a certain extent, hay feeding is very valuable in pork production. Where herbivorous animals have been maintained for an extended period on feed which was exclusively of a concentrated nature derangement of digestion has resulted.

CHEMICAL COMPOSITION.

From a chemical standpoint the constituents of feeds that most immediately concern the feeder are the nitrogenous substances, generally termed protein compounds, which contain a large percentage of nitrogen; the starches, sugars, etc., called carbonaceous substances or carbohydrates, from the fact that they are composed of carbon, with hydrogen and oxygen in the proportions in which they occur in water (they are termed "nitrogen-free extract" in chemical analysis), and fat, found in analysis under the heading of "ether extract." Ash is also of importance and often should be more carefully considered when feeders are making up their rations.

WATER CONTENT.

The most valuable portion of feeds is the water-free substance or dry matter of the feed. This is what remains of a feed after heating it in a drying chamber at or near the boiling point until repeated weighings show no change in weight. The amount of water present in feed is obviously an important factor. While it yields neither tissue-building material nor energy, it enters into the composition of the body and is indispensable. When animals are compelled to take into the system water beyond the normal amount undesirable results will follow. When animals are fed exclusively on roots or skim milk they do not receive more than enough to maintain bodily functions. This is readily understood when we consider that roots contain about 90 per cent and skim milk about 88 per cent of water. On the other hand, hay does not ordinarily contain more than 15 to 20 per cent of water, while grains, leguminous seeds, and milling products contain only about 10 per cent. The water content of feed is very much influenced by weather conditions, especially in the case of roughage, which absorbs large amounts of moisture in wet weather.

ENERGY.

A factor that is being more carefully considered in studying the value of a feed or a ration is the amount of energy which it will yield. When feed is utilized in the animal body a certain amount of heat is evolved, the process not being unlike the consumption of fuel in a furnace. This heat is converted into the energy which is necessary whenever work is performed. It is apparent, then, that a horse at hard work will need a ration that will supply more energy than one at moderate or light work. The term "work," however, has a wider significance than denoting actual muscular effort in the performance of a task. The operations of mastication, deglutition, and the contraction of the walls of the stomach and intestines involve muscular action, both voluntary and involuntary; in the movements of the heart and lungs, and the circulation of the fluids of the body, muscular action of some kind is constantly going on; in fact, the performance of nearly every function of the body is actually some form of work involving the expenditure of energy, accompanied by the evolution of heat and maintained by the energy-yielding material in the feed. The amount of work performed by an animal in the ordinary processes of "hustling for a living"—that is, finding its feed, eating it, and digesting it—is enormous. In experiments, reviewed in the following pages, with suckling pigs, Miss Wilson found that the young animals required nearly as much energy per square meter of surface as had been found by other investigators to be required by a man at hard work. It is therefore readily apparent that the heat-producing powers of feed have a very much more important function than the

maintenance of bodily warmth. The unit of energy used in computing the value of a feed from this standpoint is the "small" calorie, which is the amount of heat necessary to raise 1 gram of water 1° C.

Fats yield a greater amount of energy than either the carbohydrates or protein, there being very little less energy given up by proteids when digested than by carbohydrates.

RELATION OF FEED TO THE ANIMAL BODY.

We have seen that the most important constituents of feed are the proteids, the carbohydrates, and the fats. These are practically all that the feeder considers in making up his rations, although the physiologist must consider other compounds which exist in smaller quantities. In the body we find, in the water-free matter, the proteids, the fat, and the ash.

The following table shows graphically the relation between the constituents of the feed and those of the body—that is, the disposition of the feed:

Disposition of feed in the body.

Feed.	Body.
Water	Water.
Proteids	Proteids.
Carbohydrates	Fat.
Fat	
Proteids (rarely)	
Ash	Ash.
Fat	Energy.
Carbohydrates	
Proteids	

It is seen that the water of the feed reappears as the water in the body. The proteids in the feed form the proteids in the body. The fat of the body is formed from the carbohydrates and fat of the feed and occasionally from the proteids. The ash of the body, such as the mineral matter of the bones, comes from the ash of the feed. The three principal feed constituents—fat, carbohydrates, and protein—yield energy in the order named, fat yielding the most energy for an equal weight of feed. The carbohydrates and proteids are practically equal in heat-yielding power.

Now, as different animals have different demands made upon them, we must expect them to require these constituents of feed in different proportions. To be more explicit, a young and growing animal is building up tissue rapidly, and this should be largely muscular and bony if the best health is maintained. Muscular tissue is largely made up of proteids, and we therefore expect a large amount of protein matter in the feed. There should also be a plentiful supply of mineral matter and phosphates so that the skeleton may be properly built up. As milk is rich in nitrogenous material, we find it an excellent feed for

growing animals. Again, animals that are to be fattened rapidly must have a large amount of fat-producing material in the ration, for which reason farmers find corn such a valuable feed for this purpose. Horses that are at hard work require a ration that will give an ample supply of energy. The large amount of energy yielded by fattening rations and heavy-working rations has an interesting bearing on the shelter requirements. Steers that are on full feed can enjoy themselves in the coldest weather if provided with a simple shed that will protect them from cold winds, rain, and snow, and human beings readily recognize the fact that where a large amount of exercise is indulged in with ample food a much greater amount of cold may be endured than where no exercise is taken and the ration is light.

DIGESTIBILITY OF FEED.

The amount of nutritive material which an animal can get from his feed is a very important factor. It is obvious that when skim milk or roots are fed alone immense quantities must be eaten to give a sufficient amount of nutritive material. A similar condition is met with when feeds having a low digestibility are given. For instance, when animals are wintered at straw stacks they acquire large stomachs by reason of gorging themselves with coarse, bulky feed, and generally have a half-starved appearance because they are not able to obtain from such feed an adequate amount of nourishment to maintain flesh and condition. Hay and straw contain large amounts of crude fiber, which is composed of carbohydrate material, largely cellulose, and which is only partially digestible. The crude fiber in grains is insignificant, except in the hulls, and hence their higher digestibility.

THE NUTRITIVE RATIO.

In discussing feeding the term "nutritive ratio" is frequently met. This means simply the ratio between the total amount of digestible protein in a ration (that is, one day's feed) to the total amount of digestible carbohydrates plus 2.25 times the digestible fat. The fat is of greater value for the purpose of yielding energy than the carbohydrates, and chemists have determined that this ratio is about 2.25; hence the reason for this factor in the computation of a ration. As the functions of the fat and the carbohydrates are very similar, the reason is apparent for the addition of the former. There are many publications available that discuss in detail the computation of rations. One of the principal things to avoid is getting a ration which, while correct so far as nutritive ratio is concerned, can not be fed successfully on account of its low digestibility or high water content.

PREPARATION OF FEED AND METHODS OF FEEDING.

Investigation of the different methods of preparing feed was one of the earliest efforts of the experiment stations made in animal hus-

bandry. Perhaps the first phase of the subject to be studied was the utility of cooking feed; indeed, long before the establishment of experiment stations in the different States individual investigations and agricultural colleges had pretty thoroughly covered this subject. Their results may be summed up by stating that for fattening pigs cooking is an expensive practice, the results not being in proportion to the added cost. However, for breeding stock and sick animals, and for animals which it is desired to put into the very highest condition, cooking may be practiced with good results if expense is disregarded. Pigs so fed show marked thriftiness and health.

The utility of grinding grain is, however, still under investigation. Whereas the almost universal opinion is that, with the exceptions mentioned, cooking feed is not to be advised, the results of experiments to compare ground and unground grain are not yet regarded as showing beyond question that grinding is or is not a wise and economical practice.

The theory of grinding grain is that when the feed is in the condition of a meal it is more readily or quickly available for digestion. It is fallacious to claim that a feed given as meal contains more digestible matter than the same feed before it has been reduced to the condition of meal, for that is a thing that is obviously impossible; but it is not, perhaps, incorrect to say that the digestive fluids may be more effective in their action on feed that has been crushed or ground, and that less undigested matter is voided by the animal than when whole grain is given. The amount of the feed that is absorbed (digested) in its passage through the body, plus the undigested nutrient content of the excrement, practically equals the total digestible matter in the feed before eaten. All practical feeders readily recognize the great possibility of loss by way of the excrement when feeding steers on shelled or ear corn, and to obviate this they use hogs to consume the waste. Some waste is inevitable. There can not be perfect feeds or perfect digestions, but we may avoid wasteful methods, and the feeder's problem is to render the loss of feed in the manure as small as possible. It is unnecessary to remark that grain which is swallowed without being masticated is much more likely to pass undigested than when thoroughly masticated before swallowing. The kind of grain that is more readily masticated when fed whole would therefore seem to be less in need of grinding than that which is more generally swallowed without thorough mastication.

Results at the Central Experimental Farm [a] of Canada showed that the smaller grains, such as oats and barley, generally passed through the alimentary canal of pigs with the least amount digested. The average of nineteen experiments with 297 pigs at six experiment sta-

[a] Bul. No. 33.

tions where corn meal and whole shelled corn were compared show[a] the feed per 100 pounds of gain to be 524 pounds where whole corn was fed and 479 pounds where corn meal was fed—a difference of nearly 8.59 per cent in favor of grinding. Henry's[b] researches at the Wisconsin Experiment Station have been the most exhaustive which have been undertaken on this subject.

In twelve tests, covering seven years of work, with a total of 210 pigs, he found a saving of feed from grinding in nine instances, the highest being 17.6 per cent and the lowest 3 per cent. In the three cases where there was a loss it was, respectively, 9 per cent, 2 per cent, and 1 per cent.

Grisdale found in comparing ground and whole pease that the pigs on both feeds made practically the same gains, but those on the ground feed ate only 276 pounds per 100 pounds of gain, as compared with 333 pounds of feed per 100 pounds of gain with the pigs on whole pease—a saving of 17 per cent by grinding the grain.[c]

The amount of material available on the subject of grinding small grain is not so voluminous as that pertaining to corn. In the United States a great amount of the oats, wheat, barley, or rye fed is in the form of mill products and is, of course, ground. These feeds are, moreover, generally used as supplements to corn, and the greater attention has been directed to methods of corn feeding on this account. In common practice, perhaps, these grains are ground more generally than corn, as they are usually much harder. Their greater liability to pass through the animal undigested shows the correctness of such practice.

At the Colorado Station[d] four tests with ground and unground bald barley and three with ground and whole common barley showed larger gains and a marked saving of feed with the ground grain.

The average of ten tests with 69 pigs at five other stations shows gains[e] at a cost of 473 pounds of feed where small grains were fed whole and 415 pounds when they were fed as meal—a saving of 12.26 per cent by grinding. Soaking feed for pigs has been the general custom among farmers, but within recent years some feeders have adopted the practice of giving all grain dry, especially during winter in cold climates where wet feed is easily chilled or frozen. Considerable attention has been given this subject by experiment stations.

The writer has averaged the results at eight stations, comprising twelve tests in all, with 89 pigs. Dry feed showed gains at a cost of 444 pounds of grain for 100 pounds of gain, and wet or soaked grain

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[a] Bul. No. 47, pp. 79–81, Bureau of Animal Industry.

[b] Nineteenth An. Rpt.

[c] Bull. No. 33, Central Expt. Farm.

[d] Bul. No. 40.

[e] Bul. No. 47, pp. 83–85, Bureau of Animal Industry.

gave gains at a cost of 434 pounds of grain for 100 pounds of gain—a saving of slightly over 2 per cent in favor of feeding grain wet or soaked. At the Indiana Station, Plumb and Van Norman[a] fed pigs on dry meal, on meal plus its weight of water, meal plus twice its weight of water, and meal plus three times its weight of water. Dry feeding showed no larger gains, but they were much more economical than on wet feed. The addition of large quantities of water seemed to have no effect on either the rate or economy of gain.

The comparative feeding values of wide and narrow rations continue to be studied, and results over a series of years at the Iowa[b] and Wisconsin[c] stations have shown that for pigs a wide or carbonaceous ration gives larger and more economical gains than a narrow one. An exception is noted on two tests in Wisconsin, where a ration of pease alone gave better results than one of corn alone. These tests show, pound for pound, a greater value for pease than for corn, but it is suggested that, considering market prices of feed, corn is the cheaper. The better appetite of the pea-fed pigs was remarked upon in both tests, but especially in the last one. Some investigators have not found pease to be successful when fed alone. Day[d] states that at Guelph pea feeding resulted in poor gains and unthrifty animals, but feeding a mixture of 3 parts pea meal and 1 part middlings gave good gains and produced excellent bacon.

The effect of a narrow ration on the external appearance of the pigs was noted in the Wisconsin experiments. Toward the end of the experiment, when pea meal and shorts were compared with corn meal and rye meal, the luxuriant hair and smoother flesh of the pea-fed pigs were remarked upon. The corn-fed pigs were less smooth, had deeper wrinkles, and the flesh showed a tendency to be soft and roll over the shoulders and flanks.

CORN AND CORN SUBSTITUTES.

To the farmer of the corn belt those experiments with grains which may take the place of corn for feeding purposes in times of scarcity are always interesting. In seasons such as that of 1901, when a summer of extreme heat and little or no rain follows a spring of normal conditions, the short corn crop is frequently counterbalanced by a bountiful supply of small grains. Many farmers at such times rely on wheat, barley, oats, and rye to carry their stock to marketable condition. Outside the corn-growing districts such experiments are of even more importance, for the small grains are often grown in great abundance and form the basis of all rations.

In a comparison of whole wheat, both soaked and dry, with a ration of whole corn and one of equal parts of corn and wheat the Indiana

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[a] Bul. No. 86.
[b] Bul. No. 48.
[c] Eighteenth and Nineteenth An. Rpts.
[d] An. Rpt. 1899, Ontario Agr. Coll.

Station[a] obtained better results both in rate and economy of gain with the corn rations, but the gains from the wheat rations were satisfactory.

The Utah Station[b] compared rations of ground wheat and corn meal, the ground wheat giving larger and more economical gains.

Where a ration of ground wheat was compared with one of equal parts of corn meal and pea meal, the gains were larger but slightly more expensive with the corn-fed pigs. In a rather comprehensive experiment the Nebraska Station[c] compared various rations in which corn, wheat, or rye were fed alone or in combination with each other or with shorts. Dry ground wheat gave the greatest returns and the least amount of grain required for 100 pounds of gain, but did not return so large a profit as soaked whole wheat, owing to the expense of grinding. A ration of ground wheat and corn gave considerably better results than one of ground wheat and rye or ground wheat and shorts. Ground corn and ground rye alone did not appear to advantage. Nine experiments at the Central Experimental Farm of Canada,[d] where wheat which had been more or less damaged by frost was fed alone, ground, unground, and in combination with other grains and skim milk, show that the injury by frost did not seem to have a serious effect on the feeding value of the wheat. In the majority of instances the gains made were satisfactory, and those cases in which a large amount of grain was required for 100 pounds of gain were generally with hogs of considerable maturity, and consequently expensive feeders. Considerable study has been made of the value of barley as pig feed, and the results have been that it compares very favorably with corn, having a feeding value somewhat below that of wheat. What this grain may lack in feeding value, however, it more than supplies in its effect on the carcass. As a high-grade pig feed it far surpasses any other grain, and this fact makes possible the production of pork of the first quality in localities where corn is not a staple crop, but where barley is produced abundantly. An experiment in Canada with oats and corn showed rather small and expensive gains from oats.

The Oklahoma Station[e] compared Indian corn and Kafir corn as follows:

Six pigs, averaging about 135 pounds at the beginning of the test, were fed six weeks on Kafir heads, and made an average daily gain of 1.11 pounds, requiring about 665 pounds of grain for 100 pounds of gain.

Three pigs, averaging 220 pounds at the beginning, made an average daily gain of 1.53 pounds for thirty-five days, and required the equivalent of 494 pounds of shelled corn for 100 pounds of gain. These

[a] Bul. No. 67.
[b] Bul. No. 70.
[c] Bul. No. 75.
[d] Bul. No. 33.
[e] An. Rpt., 1898–99.

same pigs were then fed Kafir meal for two weeks and made 1 pound of gain per head daily, eating 921 pounds of meal for each 100 pounds of gain.

Four pigs, averaging 105 pounds, were fed for thirty-five days on Kafir meal. They made an average daily gain of 1.21 pounds, eating 508 pounds of meal for 100 pounds of gain. For the next two weeks they were given soaked shelled corn. They made a total gain of only 30 pounds, eating 707 pounds of corn for 100 pounds of gain. For the next four weeks a daily supply of green alfalfa was given with good effect. A total gain of 140 pounds was made, requiring 365 pounds of grain for 100 pounds of gain.

The value of Kafir corn for hogs has been studied extensively at the Kansas Station. Kafir corn was found to have a feeding value considerably below that of corn when both grains were fed alone. Cottrell[a] states that the average of a number of trials shows that 527 pounds of Kafir corn and 468 pounds of Indian corn, respectively, are required per 100 pounds of pork made; the yield of pork per bushel of grain being 10.6 pounds in case of Kafir corn and 11.9 pounds with Indian corn. On upland soil, however, the average of eleven years on the Kansas Agricultural College farm shows returns of 46 bushels per acre for Kafir corn and 34½ bushels for Indian corn. Such returns, with gains as noted above, indicate a pork yield per acre of grain at 487 pounds for Kafir corn and 410 pounds for Indian corn. The great value of Kafir corn is its ability to resist drouth.

In addition to the lighter returns from Kafir corn than from Indian corn, this grain is very constipating when fed alone, and hogs, especially young ones, tire of it sooner than they do of Indian corn. To remedy these difficulties a mixture is advised, especially with feeds of a laxative nature. One of the most convenient nitrogenous concentrates at the hands of the Kansas farmer is the soy bean.

In a series of five experiments[a] the effect of such an addition to both Indian corn and Kafir corn rations was studied. In every case increased gain was obtained by the use of soy beans, the lowest being 14.6 per cent and the highest 96.4 per cent, where a ration of Kafir corn meal four-fifths, soy-bean meal one-fifth was compared with one of Kafir corn meal alone. The amount of feed saved by the use of soy-bean meal varied from 13.2 per cent to 37.5 per cent. The amount of soy-bean meal fed was generally one-fifth of the ration and never more than one-third. In a tabulation[a] of the feed required per 100 pounds gain of 25 lots fed various rations the average was 528 pounds feed per 100 pounds gain. The lowest requirement was 369 pounds of feed per 100 pounds gain made by a lot on a ration of corn meal two-thirds, soy-bean meal one-third. The soy-bean meal rations were

[a] Bul. No. 95, Kansas Expt. Sta.

far superior to rations of Indian corn or Kafir corn alone in any condition.

The six lots of hogs having soy beans as part of their ration required an average of 411 pounds of grain for 100 pounds of gain, while the 19 lots not fed soy beans required an average of 564 pounds of feed per 100 pounds of gain, an increase in feed required of over 37 per cent. The effect of feeding soy beans is good. Hogs receiving them fatten rapidly, look thrifty, have strong appetites, and the hair and skin are glossy, like those of animals fed oil meal.

Experiments at the Utah Station[a] compared the values of pease and wheat during two years. The pigs were confined in yards and the grain given whole and dry. Pease give larger gains than wheat, and less feed was required per 100 pounds of gain.

At the South Carolina Station[b] Newman and Pickett fed to compare cowpeas with corn. The pigs were from eight to eleven months old and were fed in pens. There were 3 pigs in each lot.

The cowpea-fed lot ate 6.7 pounds of cowpeas per head daily and made an average daily gain for the lot of 3.38 pounds. They required 491 pounds of cowpeas to produce 100 pounds of gain.

The corn-fed lot ate 9.2 pounds of corn per head daily and made an average daily gain for the lot of 4.17 pounds. They required 602 pounds of corn to produce 100 pounds of gain.

With pork at 5 cents per pound and corn and cowpeas yielding 15 bushels and 10 bushels, respectively, per acre, the value of an acre of corn in this experiment was $6.97 and that of an acre of cowpeas $6.12.

At the Alabama Station[c] Duggar fed two lots of pigs to compare the relative value of a ration of half corn meal and half ground peas with that of an exclusive corn-meal ration. The pigs used were placed in covered pens, with small yards adjoining, and, after a preliminary period of a week, put into the experiment, which lasted sixty days. The results are as follows:

Ground cowpeas and corn meal compared with corn meal for pigs.

Ration.	Gain.	Number of days fed.	Feed eaten.	Feed per 100 pounds of gain.
	Pounds.		*Pounds.*	*Pounds.*
Ground corn alone	68	60	548.2	806
Corn ½, cowpeas ½	108	60	569.9	528

In this experiment the cowpea and corn-meal ration made gains 34 per cent more economical than corn alone. The quality of the pork made was as good as that of corn-fed pork.

In another experiment the Alabama Station[c] compared the feeding value of peanuts and corn meal, the peanuts being fed dry and unhulled.

[a] Bul. No. 70. [b] Bul. No. 52. [c] Bul. No. 93.

Rations of peanuts alone, corn meal alone, and equal parts of peanuts and corn meal were fed. The best results were obtained from the pigs on corn meal and peanuts, judging from the standpoint of rate of gain. In feed per 100 pounds of gain, the pigs on peanuts alone were the most economical feeders. The pigs on corn meal only fed and thrived poorly. Those on peanuts alone made a gain of 9 pounds per bushel of peanuts, which gives peanuts a value of 27 cents per bushel with pork at 3 cents per pound, and 31½ cents per bushel when pork is at 3½ cents per pound.

At the South Carolina Station, Newman and Pickett[a] fed two lots of grade Berkshire and Duroc Jersey pigs, from eight to eleven months old, in pens, to study the relative values of peanuts and corn. On land of similar character they estimated the corn yield at 15 bushels per acre and peanuts 90 bushels, and in their investigations they found that, with exclusive corn feeding, 602 pounds of corn were required for 100 pounds of gain and with peanuts 443 pounds for 100 pounds of gain. On this basis, an acre of corn will produce 139.5 pounds of pork and an acre of peanuts 487.5 pounds, worth, respectively, when pork is 5 cents per pound, $6.97 and $24.37.

COMMERCIAL BY-PRODUCTS.

One of the prominent features of modern industry is the development of the possibilities of the by-product—the waste and offal of manufacturing establishments. Farmers have long appreciated the value of the by-products of flour mills, but of recent years many other materials have come into the market as valuable feed for farm animals. Rice mills, oil mills, and packing houses all have their by-products, which are useful in supplementing the products of the farm.

MILLING PRODUCTS.

The by-products of the flour mills have for years been bought by farmers for use in the feed box, and one of these—middlings—has come to have an unsurpassed reputation for hog feeding, especially for young animals in the early stages of fattening. With the development of milling the ingenuity of the manufacturer has enabled him to throw a host of new foods upon the market. In consequence, we have, in the first place, a by-product more completely deprived of its nutrient material, perhaps, than formerly, but more uniform in quality; and, in the second place, a greater variety of feeds with which to supply the bins. It is not alone the products of the flour mills that have value for feeding purposes. The rice mills, glucose factories, and oil mills all have by-products that are useful adjuncts to feeding operations. Indeed, most of the experimental work of recent years

[a] Bul. No. 52.

deals with the value of the by-products of these industries. In the majority of instances these feeding stuffs are best used as adjuncts to corn or corn meal, although often the proximity of feed yards to a mill cheapens the by-products sufficiently to enable the feeder to use them as the main part of the ration.

The New Hampshire Station [a] fed two lots of pigs to compare the value of a corn meal and skim milk ration to which bran had been added with one of corn meal and milk only. The addition of bran was not advantageous, larger gains being made and less feed required by the pigs on corn meal and milk. The Colorado Station [b] compared shorts and corn meal in various rations. The pigs on shorts and other grain made larger and more rapid gains than those on corn meal and other grains, but more feed was eaten and more required per 100 pounds gain. The cost per 100 pounds gain, however, was the same. The Indiana Station [c] compared a ration of corn meal and shorts with one of corn meal only. The addition of shorts in this case increased the gains and lessened the amount of feed required per 100 pounds gain. The cost per 100 pounds gain was also less when shorts were added. The South Carolina and Alabama stations have shown that some of the by-products of rice milling have as great value in pig feeding as corn meal when they are not adulterated with chaff, bran, or other inferior substances. These products are sold under the names of rice meal, rice polish, rice flour, etc., and vary in composition according to the caprice of the miller—rice meal, for example, very often containing large quantities of rice bran, which is of little feeding value, and hence decreases the utility of the by-products with which it may be mixed. An experiment at the South Carolina Station [d] showed somewhat larger and more rapid gains from a ration of rice meal and skim milk than from a ration of corn meal and skim milk. The cost per 100 pounds gain from the rice ration was much cheaper.

The Alabama Station [e] reports seven tests with rice polish. It was compared with corn meal with and without the addition of skim milk, and in a mixed ration of cowpea meal and wheat bran; with a ration of one-half cowpea meal, one-fourth corn meal, and one-fourth rice bran, with the addition of skim milk; and in different proportions with other feeds without skim milk. The pigs used were generally recently weaned and the meal was fed dry.

The pigs on rice polish made more rapid gains than those on corn meal or mixed-grain rations, and in all but two cases the rice-polish ration was more economical. This station summarized the results where rice polish and corn meal were compared directly, and found that an average of 373 pounds of rice polish were required to produce

[a] Bul. No. 66. [b] Bul. No. 74. [c] Bul. No. 71. [d] Bul. No. 55. [e] Bul. No. 122.

100 pounds gain, as compared with 474 pounds of corn meal. "At this rate, 78.6 pounds of rice polish were equal to 100 pounds of corn meal, a saving of 21.4 per cent of the grain by the substitution of polish for corn meal."

In Massachusetts the Hatch Station[a] compared hominy meal and corn meal. The latter is described as consisting of "the hulls, germs, and some of the starch and gluten of the corn ground together. This separation is said to be brought about solely by the aid of machinery. The hard flint part of the corn is the hominy, which is used as a human food." Milk was given to all lots. The results seem to show that hominy meal has a feeding value equal to that of corn meal. In this one test corn meal failed to give quite so good results as the hominy meal, showing an average daily gain of 1.28 pounds to 1.39 pounds for hominy meal and 320 pounds dry matter for 100 pounds gain to 306 pounds dry matter for 100 pounds gain in the case of the hominy meal.

Two tests were made at the Hatch Station[a] to compare corn meal and cerealine feed. Like hominy meal, cerealine feed "consists also of the hull and a portion of the starch of the corn. It contains rather less of the starch than the hominy meal. It is the by-product resulting from the preparation of the breakfast food known as cerealine flakes. It is very coarse looking and appears very much like unground corn hulls." In these tests cerealine feed showed considerable value as a pig feed, but failed to give as good results, either in rate or economy of gain, as corn meal. Digestion experiments at the Hatch Station with sheep have shown that cerealine feed contains as much digestible matter as corn meal. The station authorities suggest that the coarse nature of cerealine feed lessens its value as a pig feed.

An experiment at the Maryland Station[b] to compare the value of gluten and linseed meals to balance a pig's ration gave results in favor of gluten meal. The rate of gain, feed per 100 pounds gain, and cost of gain all favored this by-product.

COTTON-SEED MEAL.

No feed of the South has so wide a range of interest as cotton-seed meal. It is depended upon by feeders of cattle and sheep in all parts of the country to balance their rations, and it has an effect on the fertilizing value of the manure which is nearly as great as its effect on the feeding value of the ration. In many parts of the South and in foreign countries cotton seed and cotton-seed meal are applied directly to the land as fertilizers.

For cattle and sheep feeding cotton seed and cotton-seed meal may be fed with reasonable safety. When fed to cattle for long periods

[a] Eleventh An. Rpt. [b] Bul. No. 63.

in large quantities it is said to sometimes cause blindness, and occasionally death. With hogs, however, feeding is usually fatal in from three to ten weeks after it commences, the mortality being at least 50 per cent where remedial measures are not adopted.

Poisoning manifests itself in not less than three weeks from the beginning of feeding. The suddenness of the attack is such that it is often difficult to observe symptoms. In many cases pigs that are apparently well in the evening are found dead in the morning, and often the most careful watching fails to show any indications of indisposition. Where symptoms are present, those most characteristic seem to be disorder of respiration, which is manifested by quickened breathing, coughing, or hiccough. Failing appetite usually calls the attention of the feeder to the approach of danger. Seldom more than two days intervene between the first symptom and death. Postmortem examination shows congestion of the lungs and often the presence of fluid in the chest cavity. Dinwiddie[a] found an intense congestion of the liver and kidneys and large quantities of fluid in the chest cavity. He gives the immediate cause of death as suffocation due to the pressure on the lungs of the fluid which accumulates in the chest cavity. He suggests an alteration in the composition of the blood as the primary effect of cotton-seed meal poisoning.

The nature of the poisonous property of cotton-seed meal is not yet known. It is not even definitely settled whether it is of the nature of a toxin, for results are contradictory whether the amount of cotton seed or cotton-seed meal is more important than the length of time the feeds are given. The only treatment possible is an instant change of feed as soon as symptoms of poisoning appear. Cotton seed should be taken out of the ration and the pigs given roots, green feed, or a run on good succulent pasture. If not too late, they will be entirely well in a week.

While some experimenters have reached results which lead them to have a small appreciation of its value for feeding purposes under any circumstances, others have reached the conclusion that, if some means can be devised to prevent poisoning, cotton seed and cotton-seed meal are feeds of great value. The Kentucky, Wisconsin, Iowa, Kansas, and Oklahoma stations have published results which show that cotton-seed meal has considerable value for feeding pigs, if death losses can be averted. At the Wisconsin Station[b] pigs on a cotton-seed meal ration required 5 per cent less feed than those on a ration to which oil meal was added. At the Iowa Station[c] pigs on a ration of which 1 pound daily was cotton-seed meal made better gains than others on a ration one-half pound of which was cotton-seed meal, and better than pigs on rations in which there was no cotton-seed meal.

[a] Bul. No. 76, Arkansas Expt. Sta. [b] Eleventh An. Rpt. [c] Bul. No. 28.

At the Kansas Station[a] six pigs that had been stunted by being fed corn meal or ground wheat exclusively were placed on rations of corn meal three-fourths, cotton-seed meal one-fourth, and equal parts of these meals. The effect is described as "magical" and immediate; the pigs began to gain in weight at once, and those receiving the greater amount of cotton-seed meal made the greater gains. No other feed was given, and the feeding was satisfactory until the forty-fifth day of the experiment, when the first pig died.

The Oklahoma Station has made an extensive study of the possibility of feeding this by-product so that good returns may be obtained with little or no danger from poisoning. The conditions under which it has been found that cotton-seed meal may generally be fed safely are (1) where pigs have access to range and plenty of green pasture, and (2) where periods of cotton-seed meal feeding of three to four weeks' duration without pasture are alternated with a period on pasture or on a ration from which the cotton-seed meal has been omitted.

Following up this system, the Oklahoma Station has conducted three experiments. In the first trial, in 1900, the alternating method was tried with 17 thrifty shoats of various sizes.[b] They were put on a ration composed of one-fifth cotton-seed meal and four-fifths Kafir-corn meal and had the run of a large paddock, where they got a little green stuff. The trial began March 22. For twenty-seven days the cotton-seed meal ration was fed; then for fourteen days Kafir-corn meal alone, next fourteen days on one-fifth cotton-seed meal and four-fifths Kafir-corn meal, then seven days without the cotton-seed meal, closing with five days on the original ration. "None of the pigs had died, and all made very fair gains on a moderate amount of grain." At the close of this trial part of the pigs were sold and the rest continued on the cotton-seed meal ration, with which the trial closed (one-fifth cotton-seed meal and four-fifths Kafir-corn meal). They were fed on this ration without change until July 14 with the loss of 1 pig only.

In the second trial of the same year 16 stunted shoats, about a year old and averaging 79 pounds, were used. For twenty-six days from April 12 they were hurdled on wheat and fed a light ration of one-fifth cotton-seed meal and four-fifths Kafir-corn meal. There was no ill effect from the grain ration. The gains averaged 0.96 pound per head daily and were made economically. On May 8 the pigs were taken from the wheat and fed the same grain ration in a lot for twenty-one days with no serious results, making an average daily gain of 1.71 pounds at the expense of 307 pounds of grain for 100 pounds gain. Five of the largest were sold after forty-seven days' continuous feeding on a cotton-seed meal ration.

The 11 pigs remaining were then given range and green feed and

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[a] Bul. No. 53.

[b] An. Rpt. 1900–1901.

the same grain ration continued. The gains made were satisfactory. There were no losses, and they were sold on July 14, after ninety-three days' continuous feeding on a cotton-seed meal ration.

In 1901, 16 uniform grade Poland China shoats, farrowed late in the previous fall, were used.[a] They were about eleven weeks old at the beginning of the experiment and averaged about 47 pounds in weight. The experiment began January 11. The pigs were divided into four lot of 4 each. Each lot was given an open pen 9 by 24 feet and had a space 8 by 8 feet in an inclosed piggery. Cob charcoal, wood ashes, and salt were always accessible, water only was given to drink, and the grain was mixed with water into the form of a thick slop just before feeding. From January 14 to April 1, 2 pounds of sugar beets were allowed each pig daily. The pigs were fed as follows: Lot I received corn meal only to April 5, then a mixture of one-fifth cotton-seed meal and four-fifths corn meal for four weeks, closing with two weeks on corn meal; Lot II received one-third corn meal and two-thirds wheat middlings; Lot III received one-fifth cotton-seed meal and four-fifths corn meal; Lot IV received one-fifth cotton-seed meal and four-fifths corn meal for four weeks, then corn meal for two weeks, next the cotton-seed meal mixture for four weeks, then back to corn meal only for two weeks, and alternating in this manner until the experiment closed.

The only signs of lack of appetite were in Lot I, where exclusive corn-meal feeding proved rather severe for such young pigs, and in Lot III, where a dullness of appetite was noticed for about two weeks. This was only temporary. One pig in Lot IV died on February 15, one week after it had been taken from the cotton-seed meal ration and placed on corn meal, and 2 pigs in Lot III died on February 20, after they had been on a cotton-seed meal ration continuously for forty days. "No further losses occurred, * * * and the pigs thrived and made good gains." One pig in Lot IV showed symptoms of sickness, but recovered.

After April 5 Lot I was given the same management and feed as Lot IV, but there were no injurious results. On the contrary, their gains increased. This was also noticed with Lot IV. During the periods that the hogs were on a straight corn-meal ration, except during the closing period, when their greater maturity enabled them to make use of a more carbonaceous ration, the gains were light and expensive, but when the cotton-seed mixture was resumed the gains were large and economical, disregarding the effect of loss by death.

The pigs which were fed cotton-seed meal and which survived made much better gains than those on corn meal only, but somewhat less than those on corn meal and middlings. The cost of the cotton-seed meal lots was the least in the experiment.

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[a] Bul. No. 15, Oklahoma Expt. Sta.

Burtis and Malone suggest that had the cotton-seed meal lots been running on green pasture from the beginning of the experiment no losses would have occurred. They also suggest the probability that a ration of one-tenth to one-fifth cotton-seed meal may be fed for an indefinite time if pigs have the run of green pasture.

The Arkansas Station found a ration of cotton-seed meal and bran to be less dangerous than one of cotton-seed meal and corn meal, and that the addition of wheat bran to a cotton-seed meal ration gave better results than roots. The gains were not so satisfactory as in the Oklahoma tests. A notable feature of the Arkansas studies was the feeding of a native sow, carrying her third litter, on a ration of cotton-seed meal 1 part and bran 3 parts for eighty days before farrowing. She ate a total amount of 112 pounds of cotton-seed meal, which was 1.39 pounds daily and 0.8 per cent of the estimated initial body weight. The ration agreed with her, and there appeared to be no harmful effects on the fetal litter, it being farrowed safely, with no stillbirths.

The Kansas, Iowa, and Oklahoma results show that a cotton-seed meal ration is valuable if the cotton-seed meal is used in a moderate amount and for a limited time. The proportion of cotton-seed meal used in the Iowa test was about one-eighteenth and one-ninth of the total grain ration at the start and about one-tenth and one-fifth at the close. Up to the time the pigs began to die the gains of those on the heavier cotton-seed meal ration were the larger and more economical (1.4 pounds average daily gain and 343 pounds meal and 250 pounds milk per 100 pounds gain). The lighter ration was about equal in results to a lot of pigs on corn-and-cob meal, gluten meal, and buttermilk, that stood second to the heavy-fed lot. The two lots returned in pounds of gain per 100 pounds of dry matter in the feed (before deaths began) 31.1 pounds and 26.4 pounds, respectively, for the pigs on the heavy and the light rations. In the Kansas tests the gains before deaths commenced were also very economical; they varied in cost from considerably less than 300 pounds grain per 100 pounds gain in the case of the pigs that had been previously on the single-grain rations to 350 pounds grain per 100 pounds gain in the case of the sows.

The same is true of the Oklahoma tests. The feed required per 100 pounds gain was less than 400 pounds for the pigs which survived a period of one hundred and twenty-six days' feeding on cotton-seed meal, and the gains averaged over 1 pound daily.

The use of cotton-seed meal in the feed lot must be very carefully guarded, especially until the conditions under which it may be used without danger and the circumstances which govern the demonstration of its poisonous properties are more thoroughly understood. The feeding of the cotton-seed meal which the South produces is one of the greatest problems of agriculture in that section yet to be solved satisfactorily. It is not difficult to appreciate what may be gained if

some of this by-product, which has such high feeding and fertilizing value, and which is exported in such enormous quantities, can be converted into pork products, which are now largely imported from other States.

FEEDING PACKING-HOUSE BY-PRODUCTS.

The frugality of the modern meat packer has become almost proverbial. Less than twenty years ago the disposal of the offal of slaughtering was a problem, but at present there is very little waste, and the packer has actually come to regard the by-products as the principal source of profit in his business. The preparation of these by-products for use as animal feed is one of the later developments of this branch of the industry. Fertilizers have long been prominent in the sales, the material that enters into their composition being meat scraps, blood, bone, hair, intestinal contents, etc. The use of tankage, a by-product that has had its sale entirely as a fertilizer, is growing among pig feeders, and has been studied by the Indiana Station[a] and by the Iowa Station.[b] Beef meal is also a packing-house product, whose feeding value was studied along with that of tankage in the Iowa experiment.

Tankage is made from meat scraps, fat trimmings, scrap bones, etc., which are sent to a rendering tank and cooked under a steam pressure of 40 pounds to the square inch. The grease is drawn off, and by different processes the residue is dried, ground, and packed for shipment. Occasionally pieces of the intestines and their contents, hair, etc., are found in tankage, which lessens its value as feed. Beef meal is prepared in a somewhat similar manner.

These by-products have a very high protein content, that of the tankage used in these tests being from 40 to 50 per cent and that of the beef meal used in the Iowa test showing 61.10 per cent protein. The fat content of the tankage was higher than that of the beef meal. In the Indiana test the largest and most rapid gain and the least feed requirement per 100 pounds gain was obtained by a ration of corn meal 5 parts and tankage 1 part; a ration of equal parts of corn meal and shorts 10 parts and tankage 1 part gave the cheapest gains financially. The tankage rations were better in all respects than a ration of corn meal only. In the Iowa test similar results were reached.

In the Indiana test the use of tankage lessened the amount of grain required per 100 pounds gain from 203 pounds to 175 pounds—from 38.9 to 33.5 per cent—showing tankage to be very profitable with the prices that were charged for grain in this instance.

In the Iowa test 140 pounds and 96 pounds, respectively, were saved by the use of tankage—30.4 and 20.8 per cent—not so good a record as obtained in Indiana. The difference between the money cost per

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[a] Bul. No. 96. [b] Bul. No. 65.

100 pounds of the corn-fed and tankage-fed lots was also much less than in Indiana.

The condition of the pigs in the Indiana test was remarked upon. The tankage-fed pigs handled better, had finer, silkier coats, and ate with much more relish than those on corn alone. The corn-fed lot was conspicuous by reason of its poor condition.

At the conclusion of the Indiana experiments, the pigs that had been on corn meal were given a ration of 5 parts of corn meal and 1 part tankage for forty-nine days. There was immediate improvement in their appetites, the hair softened, and the skin handled better. There was a marked improvement in growth, which contrasted strongly with the gains made while on corn meal only.

Experimenters caution stockmen to use that tankage only which has been specially prepared for feeding purposes.

The Iowa test with beef meal seems to show that it, like tankage, is valuable in a pig's ration. The corn-meal fed lot made an average daily gain of 2.08 pounds, requiring 461 pounds feed for 100 pounds gain, and making gains at a cost of $5.10 per 100 pounds. Those fed beef meal made an average daily gain of 2.40 pounds, requiring 346 pounds grain and 65 pounds beef meal for 100 pounds gain, at a cost of $4.80 per 100 pounds gain. Sixty-five pounds of tankage thus saved 115 pounds of grain—nearly 25 per cent.

DAIRY BY-PRODUCTS.

The use of the by-products of the dairy and creamery (skim milk, buttermilk, and whey) is one of the most interesting subjects of study in pork production. The value of the milk is known on every farm, although it may not be fully appreciated, and anyone who has fed pigs knows the keen appetite that these animals have for milk and its products. In the neighborhood of many large dairies pork production has become a very prominent and lucrative branch of the dairy industry.

Regarding solely their chemical composition, the by-products of the dairy contain most of the indispensable feeding constituents of the milk from which they are produced.

The residue from the separation of cream (skim milk) and that from churning (buttermilk) leave two products that contain practically all the protein and carbohydrates of the whole milk. In cheese making, the whey that is left is the least valuable of the dairy by-products, the greater part of the casein and fat of the milk being retained in the cheese. While whey is by no means worthless for feeding purposes, it can readily be seen that if skim milk and buttermilk have higher feeding values for pigs than whey, butter making and pig feeding will more profitably accompany each other than will cheese making and pig feeding. These by-products supply growing

material to young animals and provide an excellent nitrogenous balance in the fattening ration. The constituents that remain in the milk after skimming and churning are the most expensive ones, considered from the standpoint of feeding and fertilizing value, and it is largely due to this fact that dairy farming is so often a profitable business when conducted in a thorough manner.

The value of dairy by-products is not alone in their nitrogenous character. They have an effect on the digestion that brings results out of all proportion to their nutritive value and are more valuable than the nitrogenous grains to balance rations.[a] Where pigs have been for a long time on a monotonous ration, such as corn meal alone, they lose appetite, become listless and sick, and so make very unsatisfactory gains. If skim milk is given, even in very small amounts, an immediate change for the better is noticed—appetite returns and the pigs begin to gain rapidly in weight. As already stated, the gain in weight is out of all proportion to the actual amount of nutrient material in the milk, and this peculiarity has been remarked upon, not only when pigs are fed as indicated above, but also when pigs are fed a varied grain ration and skim milk in comparison with others on the grain ration only. Just why dairy by-products have this effect is not exactly known, but the suggestion has been made that they keep the digestive system in better order, and thus enable the animal actually to digest a greater percentage of his feed. The same fact has been noticed when roots and green feed are fed. Pasturing on rape, alfalfa, or the grasses probably has a similar though less marked effect.

Snyder's investigations at the Minnesota Experiment Station[b] seem to show that the action of milk is actually to make the feed more digestible. He found that milk rendered soluble from 1 to 3 per cent of the total insoluble proteids of wheat flour, and attributed its action to the soluble ferment, or enzyme, which is normally present in milk. Some milks were found to have a greater digestive action than others.

The effect of dairy by-products on the carcass is one of the most important results of such feeding. It is generally admitted that, while excellent hams and bacon may be produced without dairy by-products, the use of these by-products will result in pork of a more nearly uniform high quality.

The economy of skim-milk feeding in connection with grain has been repeatedly demonstrated. According to Henry,[c] the average of results of the Danish experimenters show that when so fed 600 pounds of skim milk has a feeding value about equal to 100 pounds of grain. At the Wisconsin Station the average of nineteen trials with propor-

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[a] Bul. No. 63, Maryland Expt. Sta.

[b] Buls. Nos. 74 and 86.

[c] Feeds and Feeding, p. 572.

tions of milk to grain varying from 1 to 9 pounds of milk for each pound of grain fed show a value of 475 pounds of skim milk for 100 pounds of meal.

Extensive experiments at the Central Experimental Farm of Canada show a value for milk of about 600 pounds for 100 pounds of grain.[a]

The value of milk with grain is also shown when rations of grain alone and of grain and milk are compared. The average of a series of experiments at the Utah Station[b] showed that where grain alone was fed in 5 tests the pigs made an average daily gain of 0.91 pound, consuming 421 pounds of dry matter per 100 pounds of gain; in 8 tests, where a grain-and-milk ration was fed, the average daily gain was 1.27 pounds and the dry matter per 100 pounds of gain 334 pounds. Results at the Tennessee Station[c] gave an average daily gain of 1 pound for pigs on a corn-meal ration, with 416 pounds dry matter consumed per 100 pounds of gain; when corn meal and skim milk were fed, the average daily gain was 2.3 pounds and the dry matter per 100 pounds of gain 293 pounds. Two years' additional tests at the same station[d] showed an average daily gain of 0.50 pound and 410 pounds of gain when corn meal only was fed; when corn meal and skim milk were fed, the average daily gain was 1.35 pounds, and the feed eaten per 100 pounds of gain 160 pounds grain and 1,190 pounds milk. The cost of 100 pounds of gain was $5.80 when no milk was given; when milk was fed it was $4.60. The profit for the group (value of the manure and cost of care not being considered) was $1.05 for the corn-meal-fed lots and $4.96 for those fed milk.

Although skim milk is of great value when fed with grain, especially corn meal, it is not a satisfactory feed by itself. Where attempts have been made to maintain pigs on skim milk alone the gains were small and the returns for the milk fed less than when grain was fed in connection with it. With grain at 75 cents per 100 pounds, Linfield[e] estimates the return for skim milk at 17 cents per 100 pounds when grain and milk are fed to pigs and only 10 cents per 100 pounds when milk is fed alone.

The quantity of milk may be greater with pigs suckling the dam or newly weaned than with older shoats, but young pigs should not be maintained exclusively on skim milk. The Tennessee Station, feeding pigs averaging from 75 to 100 pounds on rations composed of mixed grain and milk in varying proportions from 1:3 to 1:12, found the best results when the ratio of grain to milk was 1 to 3. The rations containing the large amount of milk were found to be unduly expensive. At the Cornell Station[f] two experiments showed the best

[a] See Bul. No. 47, p. 143, Bureau of Animal Industry.
[b] Bul. No. 57.
[c] Vol. XV, Bul. No. 1
[d] Vol. XVI, No. 3.
[e] Bul. No. 57, Utah Expt. Sta.
[f] Bul. No. 199.

results when this ratio was 1:3 and 1:2.5; in two others proportions of 1:6.7 and 1:6.2 showed the best results.

When an unlimited supply of milk is available the Hatch Station[a] recommends the following ration for young and growing pigs weighing from 20 to 180 pounds:

Rations for growing pigs.

Weight of pigs.	Rations.
20 to 60 pounds	3 ounces of corn meal to each quart of milk.
60 to 100 pounds	6 ounces of corn meal to each quart of milk.
100 to 180 pounds	8 ounces of corn meal to each quart of milk.

The following rations may be used where the milk supply is in limited amounts:

Rations for growing pigs.

Weight of pigs.	Rations.
20 to 180 pounds	3 ounces of corn meal, wheat, rye, or hominy meals to each quart of milk, and then gradually increase meal to satisfy appetites.
20 to 60 pounds	Milk at disposal, plus mixture of one-third corn meal, one-third wheat bran, and one-third gluten meal to satisfy appetites.
60 to 100 pounds	Milk at disposal, plus mixture of one-half corn meal, one-fourth wheat bran, and one-fourth gluten meal to satisfy appetites.
100 to 180 pounds	Milk at disposal, plus mixture of two-thirds corn meal, one-sixth wheat bran, and one-sixth gluten meal to satisfy appetites.
20 to 60 pounds	3 ounces of corn meal to each quart of milk, and 4 ounces of gluten feed as a substitute for quart of milk.
60 to 100 pounds	Milk at disposal, and mixture of one-half corn meal and one-half gluten feed to satisfy appetites.
100 to 180 pounds	Milk at disposal, and mixture of two-thirds corn meal and one-third gluten feed to satisfy appetites.

Whey also has great value as an adjunct of the grain ration. The average of four experiments at the Ontario Agricultural College gives a feeding value about one-eleventh that of corn; that is, 1,100 pounds of whey are worth 100 pounds of grain when fed in a grain ration. According to the Ontario results, souring does not seriously impair the feeding value of whey. The four experiments show very nearly as good results from sour as from sweet whey. The injurious effects which frequently follow whey feeding and are manifested by stiffening of the joints and rheumatism were evident among the pigs fed sweet whey, but were entirely absent from those fed on the sour whey.

The cost of handling feed and caring for live stock has not been very extensively discussed in the literature on the subject. Where

[a] Eleventh An. Rpt. (Mass.)

only a few pigs are fattened annually the feeder does not notice the effect of wasteful methods, but where large numbers are fed a minimum of waste in feeding and the highest efficiency of labor are absolutely essential to profitable results. Dairying and pig feeding are so intimately related that Linfield's[a] investigations on this subject are interesting. Correspondence with various creameries in Utah, where large numbers of hogs are fed, are summed up as follows:

One creamery reports that one man would feed 1,000 hogs, clean all the pens each day, and draw the grain feed from the mill 2 miles distant. Another says that one man does all the work of feeding and cleaning out the pens for 500 hogs in five hours each day. The wages paid in each case was about $1 per day.

At both creameries the hogs are purchased when weighing from 50 to 100 pounds each, though some few are heavier. The hogs are crowded from the start, and at most not more than one hundred days are required to fit the hogs for market, and in this time 100 to 125 pounds have been added to the live weight of each hog.

By putting all of the above figures together we find that it costs five hours' labor or 50 cents to look after 500 hogs for one day, or $50 to look after 500 hogs for one hundred days. This is 10 cents for one hog for one hundred days, or for 100 pounds gain, which gives one-tenth of a cent as the labor cost of producing 1 pound of live weight of hog. It is thus evident from the results of these practical men that when handled in large numbers, as hogs may be at a creamery, the labor is a very small item in growing the hogs. If the value of the gain was reckoned at 4 cents per pound, the labor cost of producing the pork was but 2½ per cent of its selling price.

Lest these results be misleading, Linfield calls attention to the fact that the conditions were almost ideal for the greatest economy—the hogs were "short fed" and all feeding appliances and pens were so arranged as to have in view the greatest possible saving of labor. At another creamery, where the hogs were raised on the place and fed until they were fifteen months old and the accommodations were not so good, the cost reported was as large for 300 hogs as the others reported for 1,000 head. It is pointed out that on the average farm, where the number of animals is much smaller and milk must usually be hauled back to the farm, the labor cost will be very much greater.

PASTURE AND PASTURE SUBSTITUTES.

PASTURE.

There is a marked similarity between the effect of dairy by-products and pasture on the efficiency of the grain ration of pigs, which is generally out of proportion to the nutrient value of the amount consumed of these supplementary feeds, and is to be accounted for only on the theory that the digestive apparatus is kept in better order by their use and made more efficient. Except when epidemics are prevalent, and the possibility of contact with contagion induces the feeder to keep his pigs confined, an ample range on pasture will keep them in healthy condition and enable an amount and rate of gain which well

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[a] Bul. No. 57, Utah Expt. Sta.

repays for the use of the pasture. The Utah Station[a] has recently published results which confirm previous investigations on the subject. Four years' work shows that pigs on grain alone ate 4.05 pounds of feed daily and made an average daily gain of 0.94 pound, eating 430 pounds of grain for 100 pounds gain. The pigs on pasture with grain ate 4.72 pounds of grain daily, made an average daily gain of 1.21 pounds, and ate 385 pounds of grain for 100 pounds gain. The total gains average 33 per cent greater for the pigs on pasture than for those on grain alone. The average daily gains were nearly 29 per cent greater, and there was a saving of more than 10 per cent in the feed required for 100 pounds gain for the pigs on pasture. The larger amount of feed eaten by the pigs on pasture is also noteworthy, for a large consumption of feed generally leads to large gains. Two earlier tests at the same station by Linfield[b] were designed to compare the relative merits of pasture and pen feeding when pigs were fed on milk alone, on grain alone, and on milk and grain. The only pigs that showed better results in pens than on pasture were those on grain and milk. Those receiving grain alone on pasture gave very much larger gains, required less feed per 100 pounds gain, and ate more feed than those receiving grain alone in pens. Linfield suggests that either the exercise or the feed obtained by the run on pasture gave these pigs greater appetite and enabled them to digest a greater amount of feed daily. The fact that neither of the other lots showed a marked advantage from pasture might be explained by the skim milk in the ration. It is perhaps a safe proposition that in feeding pigs the best results will follow the use of dairy by-products, roots, or pasture in connection with grain, but that it is superfluous to combine two of these supplementary feeds, as their action on the digestive system seems to be similar. When attempts are made to prevent disease, however, the advantage of ample exercise must not be overlooked.

Pasture is hardly, if at all, a maintenance ration, and as the profits in feeding come from a continuous gain until the animals are sold, such a ration should be resorted to only under the pressure of extreme necessity, when the saving of grain is imperative. According to Henry,[c] no station has shown that pigs can be successfully maintained on pasture alone, if a former test by Mills at the Utah Station be excepted. Two later tests at this station by Foster and Merrill,[a] for periods of over 100 days, where four lots of pigs were pastured on alfalfa or mixed grasses, showed actual losses with two lots and very slight gains with the others, the average daily gain amounting to 0.189 pound in one case and 0.059 pound in the other. The effect of this method of feeding on the appearance of the pigs was very marked; in the 1898 test it was particularly commented upon. "The plump

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[a]Bul. No. 70. [b]Bul. No. 57. [c]Feeds and Feeding, pp. 578, 579.

rounded forms gave place to large, coarse frames and large stomachs. At the end of the experiment they looked very much larger than at the beginning, but the scales failed to show any gains. What is said above would also apply to the mixed-pasture set, only in that case the eye was not so badly deceived—small gains were made." In 1899 pigs that were receiving small amounts of feed, either milk or grain in addition to pasture, were found to have made gains very nearly in proportion to the amount of extra feed given, which Foster and Merrill regard as evidence that the pasture supplied enough feed for maintenance only.

Tests at the Oklahoma Station[a] showed a total gain of 68 pounds for 4 pigs in eight weeks—17 pounds each—where pigs were on pasture alone, while 4 others on pasture with a grain ration gained 324 pounds in the same time, an average of 81 pounds.

A sow with a litter of 5 pigs was in the same lot with the grain-fed pigs. The sow gained 61 pounds in thirty-five days, when she was removed. Her 5 pigs made a total gain of 146 pounds in the first five weeks and 96 pounds during the succeeding period of three weeks. The grain fed these pigs amounted to only 221 pounds per 100 pounds of gain.

In addition to tests mentioned in a preceding paragraph, experiments by Linfield[b] at the Utah Station show that when pigs are receiving a grain ration with dairy by-products the addition of pasture is unnecessary and adds nothing to the effectiveness of the ration or the gains made. The average of four experiments shows average daily gains of 1.03 pounds where pasture was allowed; these pigs consumed 1,544 pounds milk and 236 pounds of grain per 100 pounds of gain. The pigs without pasture consumed 1,827 pounds milk and 218 pounds of grain per 100 pounds of gain, making an average daily gain of 1.06 pounds. The amount of feed consumed daily by the pigs on pasture was somewhat less than in case of those without it. The only advantage noticed from the pasture was in the case of two lots which received skim milk only, but no grain. In the experiments where grain was fed no advantage accrued through the use of pasture, except that the pasture lots consumed nearly 300 pounds less milk per 100 pounds gain than those in pens. At 15 cents per 100 pounds, this means a difference of 45 cents per 100 pounds of pork made. The difference in grain fed was nearly 20 pounds per 100 pounds of pork made in favor of the pen-fed lots.

These results are evidence in support of the idea that the effect of dairy by-products and succulent feed in the ration is similar, and that to get the greatest amount of gain at the least expenditure of feed only one of the supplementary feeds is necessary; that the addition of pasture to a ration which already contains a large amount of dairy

[a] An. Rpt., 1898–99. [b] Bul. No. 57.

by-products is superfluous, and that the only advantage to be gained by such a method of feeding is the exercise obtained by the pigs on pasture.

GREEN SUBSTITUTES FOR PASTURE.

The lack of a permanent pasture should not deter the prospective pig feeder from engaging in the business. A prominent feature of the recent development of the industry has been the increasing use of succulent feeds, such as cereals, rape, vetches, cowpeas, sorghum, etc., which yield large amounts of feed per acre and also enable the feeder to grow his season's pasturage on a small amount of land by means of a succession of crops. Not only does this make successful pig feeding when only a limited amount of land is available, but, by restricting the amount of range allowed the hogs, removes to a large extent the objection to pasturage when exposure to disease is to be feared, yet permits the advantages of exercise and succulent feed. Rape has been most generally used for this purpose, and experiments have been reported recently by the Utah[a] and Alabama[b] stations and by the Central Experimental Farm of Canada[c]. The gains at the Canadian station were particularly good, averaging 1.27 pounds daily, the pigs eating 238 pounds of grain per 100 pounds of gain. In the Alabama test the average daily gain was 0.56 pound and the feed per 100 pounds of gain was 238 pounds. In the Utah test the average daily gain was 0.204 pound and the feed per 100 pounds gain 490 pounds.

At the close of the Alabama test the pigs were placed on second-growth rape for three weeks. They grazed one-sixth acre, eating 168 pounds corn meal and making a gain of 82 pounds, which was an average daily gain of 0.98 pound, at a cost of 205 pounds meal for 100 pounds gain. Assuming that 500 pounds of grain alone are required for 100 pounds gain, Duggar estimates the amount of the pork produced per acre from the first and second growth rape together at 512 pounds, worth at that time $20.48.

Seven shoats, averaging 41 pounds in weight, were on rape at the same station for four weeks during the late spring. They received some corn meal in addition. During the first two weeks the rape was fed to the pigs in the pens; during the remainder of the time they were hurdled. They ate 318 pounds of corn meal. The total gain in weight for the four weeks was 103 pounds, an average daily gain of 0.53 pound, 310 pounds of grain and 4,050 square feet of rape being required to produce 100 pounds of gain.

Compared with clover, the Wisconsin Station[d] found in two tests that pigs receiving a grain ration and hurdled on rape made larger and

[a] Bul. No. 70.
[b] Bul. No. 122.
[c] An. Rpt., 1900.
[d] Sixteenth and Seventeenth An. Rpts.

more economical gains than those on the same grain and hurdled on clover.

The same station[a] fed two lots of pigs on rape alone for two weeks. Two lots of 18 pigs each were taken from rations composed of grain exclusively, grain and clover, and grain and rape. They were given nothing but rape. They fed nearly all day, appeared contented, and scoured but little, but 25 of the 36 lost in weight during the two weeks they were on rape, and only 4 made gains. The total loss on 36 pigs was 60 pounds, or at the rate of 1.66 pounds per pig. The 6 pigs that had been on an exclusive grain diet lost 18 pounds, or 3 pounds each. The 8 pigs that had been on grain and clover lost 19 pounds, an average of nearly 2.33 pounds each, and the 22 pigs that were taken from a grain and rape diet lost 33 pounds, or 1.5 pounds each.

PASTURE SUBSTITUTES IN SOUTHERN STATES.

One of the most promising features of animal husbandry in the South is the large range of forage crops at command. The hog raiser is particularly benefited by these crops, many of which may be sown annually and used as substitutes for pasture. The most common Southern grazing crops for pigs are peanuts and cowpeas. Both are very highly nitrogenous and therefore are good crops to use as a supplement to a ration composed of corn, rice products, or other carbonaceous feeds. In addition to cowpeas and peanuts, chufas,[b] sorghum, soy beans, velvet beans, rape, sweet potatoes, etc., are used for pig grazing. The method of grazing is usually that of hurdling; that is, the pigs are inclosed on a small part of the field by means of portable fences. These fences are moved to ungrazed parts of the field as the plants are eaten. Nearly all the efforts of the stations have been confined to demonstrations of the feasibility of pig feeding in the South and the possibilities of grazing the forage crops which abound in that section. The Arkansas Station[c] made pork at the rate of 1,252 pounds per acre from peanuts, 592 pounds per acre from chufas, and

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[a] Seventeenth An. Rpt.

[b] Chufas are coarse plants belonging to the sedge family. Two species are used in the manner here mentioned—*Cyperus rotundus* and *C. esculentus*. According to Gray *C. rotundus* is found in sandy fields from Virginia to Florida and Texas, and is occasionally met with in the neighborhood of Philadelphia and New York City. *C. esculentus* is found in low grounds, along rivers, etc., from New Brunswick to Florida and west to Minnesota and Texas. This is the species more commonly used as feed for hogs.

These plants form small tubers which enable them to spread rapidly and form a thick, matted growth, each tuber being capable of producing a plant. The tubers are relished by hogs, but the plants are of questionable value, as it is almost impossible to eradicate them when once established, especially in sandy soils. Botanists do not advise planting them in soil that can be used for any other purpose.

[c] Bul. No. 54.

436 pounds per acre from corn, estimating the yield of corn at 30 bushels per acre. The forage crops were hurdled and the corn fed dry on the ear. In other tests at the same station both peanuts and chufas gave especially good gains. The Alabama Station[a] grazed 6 Poland China pigs on peanuts, with some corn in addition. The lot made a gain of 380.7 pounds in six weeks on an area of about one-sixth acre and ate 373 pounds of corn. Estimating corn at 40 cents per bushel and pork at 3 cents per pound, this is a return of $18.34 per acre for peanuts from this method of feeding.

On a portion of the field which was not pastured the peanuts were dug and yielded at the rate of 62.6 bushels (1,565 pounds) of dry nuts per acre. From this the total feed required to produce 100 pounds gain was estimated as 140 pounds of peanuts and 190 pounds of corn—a total of 330 pounds of concentrates, with vines eaten not estimated.

This station estimates the value of the return from peanuts in pork at $18 per acre, and states that the same land with the same fertilizers would not produce over 200 pounds of lint cotton per acre, which would be worth $10 or $12, with cotton at 5 or 6 cents per pound, while the expense of cultivating the cotton would be much greater.

In a later experiment Duggar[b] penned a litter of nine-weeks-old pigs on a two-thirds stand of Spanish peanuts just after weaning. They were on this pasture from November 4 to December 23, and ate 162 pounds of corn meal for 190 pounds gain in addition to grazing about five-sixths of an acre of peanuts. At 4 cents per pound for pork, and making allowances for the grain eaten, the return per acre for the peanuts was $10.04.

In another test[b] a sow and her litter of 9 pigs were fed from September 30 to November 4 on corn meal, skim milk, and Spanish peanuts from one-fourth acre of land. They ate 355 pounds of corn meal and 921 pounds of skim milk. The sow and pigs gained a total of 236 pounds. At 4 cents per pound for pork, valuing corn meal at $1 per 100 pounds and skim milk at 25 cents per 100 pounds and estimating 325 pounds of skim milk to be worth 100 pounds corn meal, the return per acre for the peanuts was $17.28.

In another test[b] 7 shoats, averaging nearly 100 pounds, were penned on Spanish peanuts from October 11 to November 2 and fed some corn meal. They made a total gain of 225 pounds, eating 286 pounds of corn meal and grazing the peanuts on 0.47 acre, requiring only 127 pounds of corn meal for 100 pounds gain. With the usual allowances, the return per acre for the peanuts in this test was $18.02.

In another test[b] 7 shoats were taken from corn meal, cowpea meal, and sorghum and placed on Spanish peanuts and corn meal for four weeks. They ate 333 pounds of corn meal and grazed 10,593 square

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[a] Bul. No. 93. [b] Bul. No. 122, Alabama Expt. Sta.

feet of peanuts, making a gain of 121 pounds, which was at a cost of 273 pounds grain for 100 pounds gain. The value per acre of the peanut pasture was estimated, by the usual methods, at $9.

Some of these pigs were continued by hurdling on peanut pasture and were given some grain in addition for five weeks longer. In this period the return per acre for the peanuts were estimated at $9.88.

In another test[a] a litter of 7 Poland China pigs, averaging 28 pounds in weight, were hurdled on Spanish peanuts just after weaning. The pasturing continued six weeks and no grain was fed. The total gain was 157 pounds, an average daily gain of 0.53 pound. The area grazed was 13,887 square feet, and the return per acre, with pork at 4 cents per pound, was $20.12.

The Alabama Station[b] fed one lot of pigs on a peanut field which was a poor stand, giving some corn meal additional; another lot had nothing but the peanut pasture, and a third lot corn meal only. There were 3 pigs in each lot, and they were of rather ordinary feeding qualities. In four weeks the lot on peanuts and corn meal gained 38.6 pounds, those on peanuts alone gained 21.1 pounds, and those on corn meal lost 5.1 pounds. The lot on peanuts and corn meal ate 206 pounds of corn per 100 pounds gain and grazed 2,025 square feet planted in peanuts. "This is at the rate 840 pounds of growth from 1 acre of peanuts (with less than half a stand) and 1,710 pounds (35.6 bushels) of corn meal. With pork at 3 cents per pound and corn meal at 40 cents per bushel of 48 pounds, this is a gross return of $25.20 and a net return (after subtracting the value of the meal) of $10.94 per acre of peanuts."

The pigs on peanuts only "pastured an area of 3,517 square feet, and the gain made was 21.1 pounds, which is at the rate of 261 pounds of pork per acre. At 3 cents per pound gross for pork, this gives a value of $7.83 to the acre of peanuts on which there was only half a stand of plants."

The Alabama Station estimates the value of peanuts in pork production at $12 to $20 per acre, the higher returns being made where corn meal supplements the peanut pasture.

In another test at the Alabama Station,[a] pigs grazing peanuts, with a half ration of a mixture of corn meal 2 parts and cowpea meal 1 part, pigs grazing peanuts alone, and pigs grazing chufas with the half-grain ration mentioned, were compared with pigs on a full ration of the same grain mixture, fed in a bare lot. All lots but those grazing peanuts alone made very good gains. The pigs on peanuts and grain made an average daily gain of 1.50 pounds, requiring 188 pounds grain for 100 pounds of gain. Those on chufas and grain made 1.46 pounds

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[a] Bul. No. 122, Alabama Expt. Sta. [b] Bul. No. 93.

average daily gain and ate 192 pounds grain per 100 pounds gain. The grain-fed pigs gained 1.31 pounds daily per head, eating 431 pounds of grain per 100 pounds of gain. The pigs on peanuts only made an average daily gain of only 0.46 pound, showing that the best results may be had when grain is fed with peanuts. The return per acre of peanuts and chufas, with pork at 4 cents per pound, was estimated, where grain was fed, at $9.56 and $9.62, respectively. The pigs on peanut pasture without grain returned only $3.03 per acre for the crop. At the rate of gain made in this experiment it is estimated that with these rations 1 acre of the grazing crop would provide feed for a 100-pound shoat as follows: Peanuts and grain ration, eight hundred and fifty days; chufas and grain ration, eight hundred and twenty-seven days; peanut pasture alone, four hundred and sixty-three days.

The value of sorghum and cowpeas as grazing crops was investigated by the Alabama Station.[a] One lot was hurdled on drilled sorghum which was in the dough and ripening stages and received a half grain ration of a mixture, by weight, of corn meal 2 parts and cowpea meal 1 part. Another was placed in a pen in which sorghum was growing and had, in addition, enough ripe Spanish peanuts to constitute a half ration of peanuts. A third was hurdled on drilled Whip-poor-will cowpeas on which part of the pods were ripe, and received no grain. The fourth was confined in a bare pen and given the grain mixture given Lot I in such amount as the pigs would eat up clean.

The results were not very satisfactory for grazing on sorghum or on cowpeas without a supplementary grain ration. The waste of feed in the cowpea lot was very great, large numbers of the ripe pease falling to the ground and sprouting. Previous work at the Alabama Station has shown more satisfactory results when grain was fed in conjunction with the cowpea pasture.

Duggar[a] notes another experiment with sorghum grazing, in which there was a large waste of feed, although grain was fed. Seven shoats were on the sorghum from June 24 to September 2, 1899, and received at the same time about 1.5 pounds per head daily of a mixture of equal parts, by weight, of cowpea meal and corn meal. The pigs grazed 15,374 square feet of sorghum and 8,380 square feet of second-growth sorghum. They ate 812 pounds of grain, or 360 pounds of grain per 100 pounds of gain. Making allowances for the value of the grain fed, the return per acre of sorghum, with pork at 4 cents per pound, was estimated at $7.80. The second-growth sorghum produced only about one-half as much feed as the first growth. Large quantities of the sorghum were trampled under foot, and when some of it was cut and carried to the pigs a given area lasted much longer than when they were turned in to graze. Duggar suggests that when labor is

[a] Bul. No. 122, Alabama Expt. Sta.

cheap and abundant or a corn harvester is available soiling sorghum will be the more profitable method of feeding.

An earlier experiment at the Alabama Station[a] gave more profitable results from a ration of grain and cowpea pasture. One lot of pigs had corn only; another was hurdled on cowpeas about half matured at the beginning of the experiment and given corn. The cowpeas yielded about 13 bushels of pease per acre. The pigs on corn alone made an average daily gain of 0.36 pound, eating 586 pounds of grain per 100 pounds of gain. Those on cowpea pasture with corn made an average daily gain of 0.97 pound, eating 374 pounds of corn per 100 pounds of gain.

The pigs were pastured on an area of 7,280 square feet, or about one-sixth of an acre. Valuing pork at 3 cents per pound and corn at 40 cents per bushel, the return for cowpeas per acre was estimated at $10.65, not including the value of the manure made. By pasturing, 277 pounds of corn were saved per 100 pounds gain, and therefore an acre of cowpeas would replace 1,662 pounds of corn, using this test as a basis.

The Maryland Station[b] fed a number of pigs on cowpea pasture and concluded that cowpeas are well adapted to pigs about three months old. The older pigs that had been highly fed and had always been kept in a pen evidently had lost their rustling ability and did not thrive so well on cowpeas.

The abundant variety of forage plants at the command of Southern farmers led Duggar to suggest a succession of grazing crops which could be planted in the milder portions of the South, so that pasture would be available from January to December. The following table shows the crops suggested, using the results of investigation by the Alabama Station as a basis; it is said that other forage crops will be added as they are tested, such as alfalfa, pumpkins, artichokes, and soy beans:

Succession of forage crops.[a]

Months to be used.	Crops.
January and February	Fall-sown rape and chufas.
March 1 to April 15	Fall-sown rape, vetches and oats, rye, wheat, etc.
April 16 to May 1	Vetches and oats, crimson clover, oats, and wheat.
May	Spring-sown rape, vetches and oats, wheat, and the usual pastures.
June	Spring-sown rape, stubble fields, turf oats, and the usual pastures.
July and August	Sorghum, early varieties of cowpeas, and the usual pastures.
September, October, and November	Spanish peanuts, cowpeas, sweet potatoes, and sorghum.
December	Chufas and fall-sown rape.

[a] Bul. No. 122, Alabama Expt. Sta.

A disadvantage of grazing pigs on peanuts or chufas, the effects of which must be guarded against by the Southern feeder, is that the lard

[a] Bul. No. 93, Alabama Expt. Sta. [b] Bul. No. 63.

from such pigs has a very low melting point; the fat, therefore, makes the flesh soft, flabby, and undesirable in appearance, especially during the summer months. To obviate this difficulty the common practice of farmers is to use corn in finishing hogs which have had peanuts as the principal component of the ration. Recently the effect of cotton-seed meal on the fat has been investigated, with good results so far as increased firmness of the pork produced is concerned.

According to Bennett,[a] if good grade or purebred pigs are grazed on peanuts or chufas, either alone or combined, and if at the same time they are fed an amount of corn sufficient to full feed exclusively for four weeks, the quality of the pork and lard produced can not be distinguished in appearance from that of pigs fed on corn exclusively. Bennett[a] regards the use of more than this amount of corn as too expensive for the results obtained. He also reports that his results have shown that purebred pigs or good grades produce a firmer quality of pork and lard than scrubs. The range of individual variation in the melting point of lard from scrubs was much larger than that of the lard from grades and purebreds. Duggar,[b] however, states that in his experience, even when fed a month exclusively on corn, pigs formerly on peanuts made much more oily and soft pork and lard than those fed corn throughout the entire feeding period. This condition was noticeable even after cooking. "One month of exclusive corn feeding increased the firmness of pork made from animals previously fed on peanuts alone, but the improvement was not sufficient to make the flesh or the lard as firm as the same articles afforded by animals fed entirely on corn." Both Bennett and Duggar state that while exclusive peanut feeding injures the sale of lard and pork by making it soft and oily the cooking quality does not seem to be impaired.

It is also given as the experience of both these stations that feeding exclusively on corn for a month after the feeding on peanuts was stopped did not have an effect on the melting point of the fat that was appreciably different from that of hogs fed corn simultaneously with the peanut grazing. The melting point is lower in the case of immature pigs than with mature ones. The hardening effect of other feeds than corn and of combinations of these feeds with corn has been studied extensively by the Alabama Station,[c] where a pig that was fed a ration of one-third ground cowpeas and two-thirds corn meal was compared with pigs which had grazed sorghum, peanuts, or chufas, with and without grain. The melting point of the fat of the jowl was found to be 4.6° F. higher than in the case of pigs which had the same grain ration but had grazed peanuts and sorghum, and still higher than that from pigs which had grazed cowpeas. A number of experi-

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[a] Bul. No. 65, Arkansas Expt. Sta.
[b] Bul. No. 93, Alabama Expt. Sta.
[c] Bul. No. 122.

ments show that a ration in which cotton-seed meal entered to the extent of one-fourth had a marked effect on the hardness of the fat.

PUMPKINS AND APPLES.

Farmers generally regard pumpkins highly as a fall pig feed. They are succulent, palatable, and nutritious, and, properly fed, give profitable returns. Experiments at three stations[a] where the utility of cooking pumpkins was studied, show that the practice added little to the efficiency of the ration. The gains from feeding were good in all cases and economically produced. Pigs fed on raw pumpkins and grain showed gains at a cost of 262 pounds of grain and 376 pounds of pumpkins per 100 pounds of gain where the pumpkins were fed raw, and 222 pounds of grain and 1,150 pounds of pumpkins for each 100 pounds of gain when they were cooked.

Three pigs, averaging 141 pounds at the beginning of the experiment, fed pumpkins alone at the New Hampshire Station[b] for twenty-five days, made an average daily gain of 1.12 pounds, the cost of feed per 100 pounds of gain being $2.39.

Another test at the same station[c] with a ration of cider or windfall apples and pumpkins, equal parts, cooked, showed good but expensive gains, the high cost being attributed to the apples.

ROOTS AND TUBERS.

Feeding roots to live stock is comparatively recent in the United States. Corn, with hay and ensilage, has been the principal maintenance during the winter months when pasture was not available. In hog feeding it is safe to say that, until very recent years, almost the only substitutes for pasture were pumpkins, artichokes, and clover or alfalfa hay in certain sections. In England and Canada, however, much dependence is placed on roots, and while we may never reach the point in this country generally of fattening animals almost entirely on a root diet, the peculiar advantages to be gained by them, their great palatability, and the good effect on the health and thrift of the animal commend roots to the stockman.

A number of experiments have been reported recently on feeding roots to hogs.

At the Indiana Station Plumb and Van Norman[d] conducted two experiments to compare a ration composed solely of grain with one where roots were added. In both experiments the grain ration was 1 part corn meal, 2 parts shorts, fed as slop. No drink other than water was given. In the first experiment mangels were fed; in the second the roots were sugar beets sliced and fed in the slop, and they were relished more than the mangels.

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[a] Bul. No. 47, Bureau of Animal Industry.

[b] Bul. No. 66.

[c] Bul. No. 66.

[d] Buls. Nos. 79 and 82.

At the Ontario Agricultural College Day[a] fed four lots of pigs in pens as follows:

Lots I and II were made up of 4 grade Yorkshire pigs, each from the same litter, about 7 weeks old; Lots III and IV contained 5 grade Yorkshire pigs, each from the same litter, about 9 weeks old. Lot I received barley and middlings; Lot II received barley and middlings with an equal weight of raw pulped mangels; Lot III received corn and middlings; Lot IV received corn and middlings with an equal weight of raw pulped mangels. The proportion of grain in middlings was 1:2 in all lots at the beginning of the experiment, and was gradually changed as the pigs increased in weight and age until it was 2:1 toward the close.

At the Utah Station Foster and Merrill[b] conducted two experiments to compare a ration of bran and sugar beets with rations of corn meal, ground wheat, and corn meal and peas. In the first experiment Lot I received corn meal, Lot II received ground wheat, and Lot III received sugar beets with a one-third ration of bran. In the second experiment Lot I received a mixture of equal parts of corn meal and ground peas, Lots II and III being fed as in the first test. The pigs were fed in covered pens, and were given all they would eat. There were 3 in each lot.

At the Montana Station Shaw[c] fed one lot of hogs on grain only and another on the same grain ration with sugar beets added.

The Indiana results showed larger and more rapid gains in both cases for the pigs receiving no roots, but in one test there was a saving of 72 pounds of grain for 100 pounds of gain by feeding 410 pounds of roots. The Ontario and Montana results favored root feeding in all respects. The gains were larger and more rapid, and less feed per 100 pounds of gain was required when roots were fed. The average of these experiments show that in six out of seven tests where roots were fed there was a saving of grain.

The average of feed per 100 pounds gain shows that feeding 427 pounds of roots saved 83 pounds of grain, or 19 per cent, which is a very high value for roots.

This feature of root feeding has previously been remarked upon in this bulletin. Attention is called to it in nearly every instance where experimenters have feed roots successfully. Plumb and Van Norman[d] do not regard their results as showing great value for roots, but think that they have an effect on the appetite, digestion, and general health that is beneficial, particularly in winter. In the Ontario[b] experiments the equivalent for 100 pounds of meal was 319 pounds of roots in the first and 564 pounds in the second. Day calls attention to the fact

[a] An. Rpt., 1901.

[b] Bul. No. 70.

[c] Bul. No. 27.

[d] Bul. No. 79, Indiana Expt. Sta.

that both figures are very high values for roots, and points out that, "according to analyses and digestion experiments, there is approximately about nine times as much digestible matter in a mixture of corn and middlings as there is in mangels. It is difficult to explain, therefore, how 564 pounds of mangels should prove equal to 100 pounds of meal." The pigs receiving mangels showed the effects of their feed in more growth and thrift than the others. They had less tendency to become fat, and the root ration was reduced for this reason. Day[a] explains this effect of root feeding to be due to a "beneficial effect on the digestive organs of the animals, causing them to digest their food better than did the others; for there is little doubt that hogs closely confined in pens are likely to suffer from indigestion." Shaw[b] explains the marked effect of roots in similar words, stating that the value for sugar beets for pigs is "derived not so much from the nutrients in the dry matter which they contain as from the influence they exert on digestion and assimilation."

Henry found the results at three American experiment stations to be that about 615 pounds of roots saved 100 pounds of grain. The Danish experiments give 600 to 800 pounds of mangels and from 400 to 800 pounds of fodder beets as the feeding equivalent of 100 pounds of grain.[c]

The average of the results here given indicates that about 515 pounds of roots saved 100 pounds of meal, a somewhat higher value for roots than that given in previously published work.

A more extended experiment conducted by Shaw[d] at the Montana Station showed an average daily gain for pigs of 1.58 pounds, at a cost of $4.60 per 100 pounds gain, on grain only (9.11 pounds of grain per head daily); a second lot, on grain and sugar beets (6.65 pounds grain and 4.58 pounds sugar beets per head daily), made an average daily gain of 1.64 pounds, at a cost of $3.80 per 100 pounds. There were 4 pigs in each lot, and they were fed fifty days. As a side light on the possibilities of pork production in the irrigated Northwest, it is interesting to note that Shaw found his net profit from feeding these 8 pigs to be $14.12, "or 33 per cent on the investment in fifty days."

In an experiment to compare the feeding value of forage beets, sugar beets, mangels, and turnips, at the Central Experimental Farm of Canada,[e] when pigs received a ration of mixed grain, the pigs on forage beets made the greatest average daily gains and required the least feed for 100 pounds gain, the other lots standing in the order of sugar beets, mangels, and turnips. The results are remarkably low in feed requirements, and would seem to show that roots and milk may be more advantageously combined than pasture and milk.

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[a] An. Rpt., 1901, Ontario Agricultural College.
[b] Bul. No. 27, Montana Expt. Sta.
[c] Feeds and Feeding, pp. 570, 571.
[d] Bul. No. 37.
[e] An. Rpt., 1901.

Day, at Guelph, and Shutt, at Ottawa, have found that the effect of roots on the carcass is not detrimental, but produces a firm bacon of good quality—a very essential matter to Canadian pig feeders. In this experiment neither buyers nor packers criticised adversely the pigs fed on turnips and mangels, and the carcasses of the sugar-beet pigs were all "select" (there was no packer's report on this lot); but the buyer found one carcass too fat in the lot fed on forage beets, and the packer's report was not so favorable as on the others.

An attempt at the Colorado Station [a] to maintain pigs on sugar beets alone was successful only in maintaining them without loss. The ration proved expensive, and there was difficulty at first in inducing the pigs to eat beets, but after they became accustomed to such a diet they took to it readily. At no time were they able to eat beets enough to approach the conventional feeding standard; 12.5 pounds daily was the greatest amount they would take.

An experiment at the same station, [a] when sugar beets and sugar-beet pulp were compared, showed that the whole beets had greater feeding value than the pulp, but both rations were inferior to one of a mixture of equal parts of wheat and barley, so far as amount and rate of gain and profits were concerned, although the pigs on beets or pulp received the same grain ration as the lot on grain alone. The beet and pulp rations required less grain for 100 pounds of gain than the grain ration, and the pulp ration cost 20 cents less per 100 pounds gain than the grain ration, but the profit on the latter lot was greatest. The pigs ate pulp with considerable reluctance, and did not seem to relish the beets at first.

Clinton [b] reports an unsuccessful attempt at Cornell to feed potatoes, raw and cooked. Some grain and skim milk were given in addition; but, while over 400 pounds of potatoes were eaten, the pigs made no progress and were getting out of condition when the experiment was brought to a close. The low temperature while the pigs were being fed, ranging between 29° and 30° F., is suggested as a reason for the poor results.

At the Central Experimental Farm [c] very satisfactory results were obtained from cooked potatoes, but raw potatoes produced little gain. In one experiment the pigs were given all the raw potatoes they would eat, but made no gain and the tubers were discontinued. In a second test a similar experience led to a change to cooked potatoes. The opinion of investigators at this station is that raw potatoes are of little value for feeding pigs, but when cooked they are worth about one-fourth as much as mixed grain.

The Alabama, South Carolina, Maryland, and Florida stations have experimented with sweet potatoes, with somewhat varying results.

[a] Bul. No. 74. [b] Bul. No. 199, Cornell University Expt. Sta. [c] Bul. No. 33.

At the Alabama Station, Duggar[a] fed one lot of pigs on a ration of three-fourths sweet potatoes and one-fourth ground cowpeas and another on a ration of equal parts of corn meal and cowpeas. After four weeks they were put through an intermediate period of one week and the rations were reversed, the lot that had formerly been on corn meal and cowpeas receiving the sweet-potato ration. This was continued for four weeks longer, so that in all there were eight weeks' feeding on a sweet-potato ration.

The ration of sweet potatoes and cowpeas proved very inferior to the ration of corn meal and cowpeas. The increase in live weight was nearly twice as great in the case of corn meal and cowpeas, and the dry matter per 100 pounds of gain was estimated at 600 pounds where sweet potatoes were fed to 360 pounds where corn meal was fed. Duggar refers to the difficulty of inducing the pigs to eat enough dry matter when sweet potatoes made up so much of the ration, and suggests a ration of equal parts of cowpeas and sweet potatoes as being more palatable and nutritious. He questions whether sweet potatoes can be profitably grown, stored, and fed to hogs unless the feeding value per bushel would be more than 10 or 15 cents. Where the pigs do the harvesting, especially on sandy soils, where the yield of sweet potatoes is ten or fifteen times that of corn, they may be an economical feed.

The results at the South Carolina Station were much more favorable to sweet potatoes. Newman and Pickett[b] fed a lot of 3 pigs, averaging 162 pounds in weight, on sweet potatoes only for forty-three days, beginning November 23. At the same time corn was fed to 3 pigs averaging 156 pounds in weight. Two pigs in each lot were high-grade Berkshires and the third was a grade Duroc Jersey.

The pigs on sweet potatoes ate 26.2 pounds per head daily and made an average daily gain of 0.86 pound. They ate 3,247 pounds of sweet potatoes for 100 pounds of gain.

The pigs on corn ate an average of 9.2 pounds of grain daily, and made an average daily gain of 1.39 pounds, requiring 602 pounds of corn for 100 pounds of gain.

It was estimated that, at 200 bushels per acre, sweet potatoes would produce 369.5 pounds of pork per acre, worth $18.47 when pork is worth 5 cents per pound. The gain from corn was 139.5 pounds of pork, and the corn yield was 15 bushels per acre on land similar to that on which the sweet potatoes were grown. At 5 cents per pound for pork, the money return for the corn was $6.97 per acre.

The Maryland Station[c] reports an attempt to maintain pigs exclusively on sweet potatoes. A lot of rather mature pigs was put on a ration of small sweet potatoes and "strings" that were fed raw twice a day for thirty-one days. It required over 5 tons of these potatoes

[a] Bul. No. 93. [b] Bul. No. 52. [c] Bul. No. 63.

for 100 pounds of gain, and the return from them was only about $1.60 per ton.

The value of this feed when given with grain was tested with a younger lot of pigs for thirty days. With this lot, 593 pounds of sweet potatoes, 277 pounds of milk, and about 60 pounds of grain were required for 100 pounds of gain, and the value per ton of the potatoes was estimated at $2.40, showing sweet potatoes to be more valuable when fed with grain and milk.

The Florida Station[a] fed a lot of 4 native hogs on a ration of equal parts, by weight, of sweet potatoes and wheat middlings, the ration being 3.5 pounds of each per 100 pounds live weight of hog. They were confined in an open pen and fed twice daily. The hogs averaged 101.5 pounds at the beginning of the test and increased in weight 31.16 per cent, or 126.5 pounds, at a cost of 5.6 cents per pound of gain for feed eaten.

At the Alabama Station, Duggar[b] penned 2 shoats, averaging 116 pounds, on sweet potatoes for thirty-five days. They were given, in addition, 2 pounds of ground corn and 1 pound of ground cowpeas per head daily. In the time specified they gained 67 pounds, an average daily gain of 0.93 pound, thus requiring 313 pounds of grain in addition to the sweet potatoes for each 100 pounds gain. Duggar states that the sweet potatoes were not relished greatly and that there was much waste of them, due probably to the relatively large amount of grain fed.

At the Oregon Station[c] French took 6 Berkshire pigs from wheat stubble on October 22 and placed them on a field of artichokes that had been planted in April on deep-plowed ground, prepared, as for potatoes, in rows 3 feet apart, with the seed 18 inches apart in the row. The growth was vigorous and the yield abundant, the tops growing to a height of 7 feet during the season, and a trial plot showing a yield of 740 bushels per acre. The pigs had free access to the field and did all the harvesting. An attempt to sustain them entirely on the tubers failing, some shorts were fed in addition.

At Ottawa, Grisdale[d] sowed a plot of one-sixteenth acre with about 70 pounds of tubers on May 19, planting in rows 24 inches apart, 4 inches deep, and 20 inches apart in the rows. Six pigs were turned in October 3. Although the tubers were immature at that time, the tops were from 10 to 13 feet high. The pigs were allowed a daily grain ration of 1.5 pounds of a mixture composed of one-half corn meal and one-half of a mixture of equal parts of ground oats, pease, and barley.

In the Oregon experiment, the pigs made an average daily gain of 0.81 pound for fifty days, eating 309 pounds of grain per 100 pounds

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[a] Bul. No. 55.
[b] Bul. No. 122.
[c] Bul. No. 54.
[d] An. Rpt. 1900, Central Experimental Farm.

of gain, at a cost of $1.85; in the Canadian test, the pigs made an average daily gain of 1.57 pounds for twenty-one days, eating 96 pounds of grain per 100 pounds of gain, which cost $1.80.

The cost of the meal in the Oregon experiment was estimated at $12 per ton; that in the Canadian one at $18 per ton. Valuing the meat made at $6.25 per 100 pounds, Grisdale estimates that, after deducting the cost of the meal fed, a balance of $10.61 is left for the artichokes fed, and deducting from this the cost of seed, planting, rent of land, etc., the one-sixteenth acre used gave a net return of pork worth $8.76.

ROUGHAGE.

Hogs are generally regarded as animals whose particular function is the conversion of concentrated feed into meat. Although the capacity for bulky feed that we find in the stomachs of cattle and sheep is lacking in hogs, a reasonable amount of bulk in the form of roots or hay is palatable and profitable. In many parts of the country, where concentrates are costly feeds, stockmen are forced to use substitutes for at least a part of the grain ration, both for fattening and maintenance, and over the entire country the winter ration is a problem. To solve these problems many western farmers have resorted to the use of alfalfa hay, and outside alfalfa districts clover hay is used. Considerable study has been devoted to this subject by the experiment stations.

The Kansas Experiment Station[a] has reported a series of experiments with drouth-resistant crops. Three of these experiments had to do with alfalfa hay. In the first, the hogs used were of mixed breeding—Berkshire and Poland China—representing about the average of Kansas farm hogs. The alfalfa was of good quality.

Two lots were fed—one receiving the hay whole in greater quantity than it would consume, the other having ground hay. In the second test the meal-fed lot received some cotton-seed meal—0.16 pound to each pound of Kafir corn, which did not affect the hogs seriously. This test was conducted during the most severe weather of the winter, the thermometer registering 32° F. below zero February 12, ten days after the experiment began.

In the third test the grain was wet with water at the time of feeding. The alfalfa hay had been cut late and was rather woody.

The Utah Station[b] fed one lot of hogs on a mixture of equal parts by weight of chopped wheat and bran, wet. Another lot had the same grain ration with chopped alfalfa hay added. "The alfalfa used was well cured and was prepared by running through an ensilage cutter, the blades of which are arranged for cutting into half-inch lengths." The pigs were thrifty grade Berkshires.

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[a] Bul. No. 95.

[b] Bul. No. 70.

The Montana Station[a] fed three lots of hogs to compare the feeding values of a grain ration with sugar beets and alfalfa hay as roughage with a ration of grain only. The lot on grain alone received a ration consisting, during the early part of the experiment, of 2 parts of damaged wheat and 1 part oats, barley taking the place of the wheat during the latter part of the experiment. The hay-fed lot had the same ration with alfalfa hay added. The alfalfa hay was run through a cutting box, moistened, and mixed with meal. The hogs were by a Berkshire boar out of high-grade Poland China sows. They had previously had the run of a stubble field, with some clover pasture.

The average of these experiments[b] shows that 593 pounds of grain were required for 100 pounds of gain when no hay was fed, and 505 pounds of grain and 89 pounds of alfalfa hay when hay was fed, a saving of 88 pounds of grain to be credited to the hay fed.

In all but two instances a considerable saving of feed was found to be effected by its use, but the statement that its feeding value is almost equal to that of corn is true only within certain limits. Where hogs are confined to an exclusive grain ration, and especially where this is made up of a single grain, the addition of a moderate amount of hay to the ration will be relished and less grain will be required. At the same time, better and cheaper gains are usually made by hogs so fed than by those on grain alone, but the value of the grain saved is out of all proportion to the value of the hay fed, and the hay in the ration can not be used economically in more than very moderate amounts. This is a similar fact to that which has been found by many investigators with such bulky feeds as green clover, rape, roots, and skim milk. That it is bad economy to attempt the maintenance of hogs on alfalfa hay alone is shown by an experiment by McDowell[c] in Nevada.

In this experiment, two lots of 2 pigs each were fed on a ration of alfalfa hay. The two lots ate in twenty-one days 99.12 pounds and 99.14 pounds, respectively, and lost in weight 33.25 pounds and 51 pounds, respectively, an average daily loss of 0.79 pound and 1.21 pounds, respectively. "While feeding hay alone the pigs spent much time curled up in the bedding, but when about the stalls were restless, and even in eating it was done in a ravenous way, unlike that of a hearty, well-fed pig." After the hay-feeding period both lots were given grain and roots and made satisfactory gains.

A consideration of the approximate proportions of hay to grain fed in these experiments is of interest. The greatest proportion of hay to grain was fed at the Kansas Station and the ratio was 1:2.5. With this ratio the least daily gain was made. The gains were the most expensive of any of the lots, and no advantage accrued from the use

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[a] Bul. No. 27.

[b] See Bul. No. 47, p. 174, Bureau of Animal Industry.

[c] Bul. No. 40, Nevada Expt. Sta.

of hay. The least proportion of hay (1:11) was fed at Utah and gave the most economical gains. The greatest daily gain and the greatest amount of grain saved was in a Kansas lot fed whole alfalfa hay and dry Kafir corn meal in the proportion of 1:7. The following table shows the effect of these rations in greater detail. The best results seem to come from the use of hay in the proportion of from one-seventh to one-fourth of the ration when hay makes up all the roughage.

Ratio of hay to grain in feeding hogs.

Ratio of hay to grain.	Average daily gain.	Feed per 100 pounds gain.		Grain saved.
		Grain.	Hay.	
Kansas:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1:2.5	0.88	538	214	1.8
1:4	1.37	501	131	139
1:4	1.37	516	123	137
1:7	1.44	515	72.4	234
1:7	1.32	538	78.7	211
Montana:				
1:7	1.19	486	67	46
Utah:				
1:11	1.19	455	41.7	9

The average[a] of experiments at the Utah and Montana stations show sugar beets to be more valuable as roughage than alfalfa hay. Pigs on hay and grain required 423 pounds of grain and 123 pounds of hay for 100 pounds of gain; those on beets required 358 pounds of grain and 617 pounds of beets for 100 pounds of gain—a difference of 65 pounds of grain, or 15 per cent, in favor of the sugar-beet rations.

Recent results at the Colorado Station[b] have been unfavorable either to hay or sugar-beet feeding for pigs. Nine Berkshire pigs, averaging about 150 pounds, were fed. Lot I received a mixture of approximately 2 parts barley and 1 part corn, and about one-half pound alfalfa hay daily; Lot II had the grain ration only; Lot III had the grain ration and about 1 pound of sugar beets daily. There was some difficulty at first to get the pigs in Lot I to eat alfalfa, but when it was cut fine and mixed with barley slop they would take it.

The pigs on grain only made the largest and most rapid gains, and required the least grain for 100 pounds of gain. These pigs also made the cheapest gains and the largest profit. The hay-fed pigs gave nearly as good gains as those fed grain only, but they required more feed, and the profits were 21 cents less per head for the ninety-seven days' feeding. The grain and sugar-beet ration was least effective and least economical. The proportion of hay to grain fed was approximately 1:11; that of beets to grain was a little more than 1:5.

[a] Bul. No. 47, pp. 175–177, Bureau of Animal Industry. [b] Bul. No. 74.

The Maryland Station[a] has conducted a number of experiments with ground corn fodder, or "new corn product," as it is otherwise called. This product is the ground residue of cornstalks from which the pith has been removed. It was fed to pigs varying in age at the beginning from eight to twelve weeks. All rations contained milk, and the fodder was fed in different proportions to note any possibly advantageous results from such a practice. No special advantages could be observed from feeding the corn fodder, either in lessening the amount of grain required for 100 pounds of gain or in lowering the cost, except after the pigs were 6 months old. For fairly mature pigs the "new corn product" probably would have an effect in a ration somewhat similar to that of alfalfa hay.

BREED TESTS.

In the foregoing pages attention has been called to the fact that there is very little difference in the standards of excellence for the various breeds of what has come to be designated the "lard," "fat," "block," or "corn-belt" hog. Tests of the different breeds made in different parts of the country show that there is very little difference in the cost of pork production by the best representatives of any of the established breeds.

One of the most striking facts to be observed in the study of breed tests by the experiment stations is the apparent contradiction of the evidence of different experiments. For example, Curtiss and Craig[b] quote Hayward, of the Pennsylvania Station, to the effect that the results obtained in Maine, Massachusetts, and Ontario show the feed eaten per 100 pounds gain by various breeds to be as follows: Poland China, 407 pounds; Berkshire, 419 pounds; Tamworth, 420 pounds; Chester White, 500 pounds; Duroc Jersey, 522 pounds.

To ascertain what results might disclose if a broader average were taken, the writer[c] averaged the feed per 100 pounds of gain found at eight experiment stations. Only those experiments were used where there was a sufficiently exhaustive test and a large enough number of pigs to make the results fairly representative. It was found that the least amount of feed for 100 pounds of gain was shown by the Tamworths, 344 pounds, and the greatest by the Duroc Jerseys, 418 pounds, the other of the six leading breeds standing in this order: Chester White, Poland China, Berkshire, Large Yorkshire. Similarly contradictory results may be found in almost every breed experiment conducted. In the Iowa tests, which covered three years, the Yorkshires averaged highest in average daily gains, with 1.04 pounds; the Berkshires and Duroc Jerseys being tied for second, with 0.98

[a] Bul. No. 63.

[b] Bul. No. 48, p. 444, Iowa Expt. Sta.

[c] Bul. No. 47, p. 178, Bureau of Animal Industry.

pound, and the others following in this order: Tamworth, Poland China, Chester White, the lowest being 0.89 pound. In feed requirement (estimated digestible dry matter for 100 pounds gain) the Duroc Jerseys were first in least requirement, with 410 pounds, the other breeds standing thus: Poland China, Yorkshire, Chester White, Tamworth, the last being 456 pounds. In cost of 100 pounds of gain the Yorkshires were lowest, with $2.14, the other breeds taking this order: Poland China, Duroc Jersey, Tamworth, Chester White, the highest being $2.46. In the work at the Ontario Agricultural College[a] the results of four tests with the same breeds show that the Duroc Jersey averaged first in average daily gains, with 1.01 pounds, the other breeds following in this order: Yorkshire, Berkshire, Tamworth, Poland China, and Chester White. There was, however, very little difference between the Duroc Jersey, Yorkshire, and Berkshire in respect of average daily gains, and the Tamworth, Poland China, and Chester White formed a second group, with average daily gains of slightly more than 0.90 pound. In the economy of gain the Berkshire stood first, with 379 pounds as the amount of meal required for 100 pounds of gain, the other breeds following in this order: Tamworth, Yorkshire, Duroc Jersey, Chester White, and Poland China. In this respect the Berkshire was quite a little in the lead. The Yorkshire and Duroc Jersey formed a group around 395 pounds and the Chester White and Poland China another group at 400 pounds. The Tamworth required 390 pounds of meal for 100 pounds gain—somewhat less than the Yorkshire and Duroc Jersey. The lowest average daily gain was 0.90 pound, and the highest amount of feed required for 100 pounds of gain 402 pounds. In the Minnesota tests,[b] on the other hand, the Tamworth and Yorkshire showed more favorable results than the Poland China.

These results undoubtedly show the truth of the rather hackneyed phrase, "There is no best breed." Given the improved breeds and there seems to be practically no difference in the feeding powers between representative animals of any of them. One breed may contain more good feeders than another, but the good judge can find among them all animals which will feed rapidly and economically. Not only is this true of the hogs of the "lard" type, but the bacon breeds must be included in the category if we accept the figures of the stations as correct. The fact that a pig is a Yorkshire or a Tamworth can not be taken as prima facie evidence that it will make slow or expensive gains.

Breed influence, however, may be noticed on the carcass. It is notorious that the low prices which are paid for American bacon on the English market are caused by the fact that the type bred in the United

[a] An. Rpts., 1896-1900. [b] Bul. No. 73.

States does not suit the English taste and that the feed given is not always that which will produce a first-class carcass. The results of experimental shipments of pork to this market are therefore particularly interesting to pig feeders. After each slaughtering of the Iowa pigs some of the pork was shipped to Liverpool for sale on the English market. Very complete reports were received regarding the suitability of these cuts abroad.

In 1897 the opinion of the packers, before the shipment was made, was that the Berkshire and Tamworth pigs were "the most suitable for the making of English meats."[a] The lots of pork that were unsuitable on account of feeding were one of long-cut hams from Poland China pigs and one of long-cut hams from Chester White pigs, which were "too fat and short." One lot of American-cut hams from the Berkshires was rendered unsuitable for the English market by cutting. Some of the cuts were criticised as soft and spongy, others as somewhat fat, but they were not necessarily condemned on account of fat. A tendency in the Yorkshire long-cut hams to be "rather stout" was remarked upon.

In 1898 a still more complete report was received concerning the cuts that were shipped to England. The cuts from the Tamworths were all reported suitable for the English trade, although some were criticised as being somewhat too fat. The Berkshire cuts were given second place, only two being condemned as being too fat for the British market. The showing of the Yorkshire cuts in this shipment was surprising. Out of eight Cumberlands cut from Yorkshire pigs only one was suitable for export, the others being "much too fat." Out of eight Yorkshire short-cut hams four were condemned on account of fat. The Yorkshire cuts were the least suitable of the shipment.

This characteristic of the Yorkshires in this experiment brings up the very important question regarding the influence of feed on the carcass. It also shows how individual and family characteristics are strong factors in experimental work. In justice to the breed it should be said that it is highly valued for its high-class pork products and is employed in every country where the production of prime bacon is a feature of pig feeding. The breed is more extensively used than any other in Denmark, where the finest bacon of international trade is produced. Yet in the Iowa tests it was said that the Yorkshires were deficient, "as the thickness of fat on the back was much greater than the trade desired."[b] The suitability of the Yorkshires for the export bacon trade is shown in the résumé on the Ontario Agricultural College work in the following paragraph:

Summarizing the results of five years of work with six breeds at

[a] Bul. No. 48, p. 391, Iowa Expt. Sta.

[b] Bul. No. 48, p. 429, Iowa Expt. Sta.

Guelph, Day would rank the Yorkshire first in suitability for the export trade, placing the Tamworth second and the Berkshire third. The showing of the other breeds that were fed (Chester White, Duroc Jersey, and Poland China) was so unsatisfactory in the production of export bacon that they could not be graded.[a] In a breed test inaugurated in collaboration with the Dominion department of agriculture the Yorkshires and Berkshires were the only breeds that made a satisfactory showing. "There were practically no culls among these breeds."[b]

FEEDING FOR PRIME BACON.

The criticism to which our bacon is open when it comes into contact with the products of other countries in the world's markets would seem to call for more attention by American feeders than has been given in the past to the production of prime bacon for the foreign trade, especially that consumed by England, which country is our best customer. The bacon from the United States forms the greater part of all this product imported by that country, but it has never equaled the Danish bacon in price, and in this respect it has generally been behind that imported from Canada also. While American bacon is said to have a better standing on this market at present than in former years, we can hardly yet claim superiority for it; and whatever advance in quality has been made must be attributed rather to the enterprise of the packers than to increased skill on the part of the breeder or the feeder.

Canadian farmers depend upon their exports of bacon to a very great extent, and its maintenance is a source of solicitude. Day, at the Ontario Agricultural College, and Grisdale and Shutt, at the Central Experimental Farm, have studied the production of export bacon during the past eight years to ascertain the best methods of feeding and breeding, and also the prevention of deleterious properties in its production.

Lack of space prevents more than a brief notice here of the studies conducted in Canada to raise the standard of the bacon from that country.[c] In meeting the problem, the most conspicuous fault found with the usual Canadian product was a tendency to softness. This was a different condition from the softness which troubles pork curers in the Southern States. It was the development of a flabby condition of the sides while they were in the salt and did not seem to depend, necessarily, on the season of the year when the pigs were slaughtered, although soft bacon appeared to be more prevalent in May, June, and July. Soft sides were more common from hogs fed in lower Ontario (Essex and Kent counties), where large quantities of corn are fed.

[a] An. Rpt., 1900, p. 48, Ontario Agricultural College.

[b] An. Rpt., 1901, p. 62, Ontario Agricultural College.

[c] The subject is reviewed at greater length in Bulletin No. 47 of the Bureau of Animal Industry.

Investigation showed that those sides were soft which contained relatively large amounts of fluid fats, principally olein, and that when the proportion of palmitin and stearin in the fat was relatively large the sides were firm. The soft tendency was also found to be more marked when immature and unfinished pigs were slaughtered than when pigs were matured and fed to a finish. The principal trouble, however, was soon traced to the large amounts of corn, and rations were devised to counteract the manifestly injurious effects of this feed. After considerable experimenting, the grain which was found to be a bacon-producing feed par excellence was barley. Not only did it produce the highest quality of bacon, but when fed in combination with corn in various ways the softening effect of the corn was prevented to a great extent. In the first series of experiments at Ottawa the bacon which showed the lowest precentage of olein was fed on rations of equal parts of oats, pease, and barley. Bacon fed on a ration of one-half corn meal and one-half of a mixture of equal parts of oats, pease, and barley compared very favorably with it. The rations which produced bacon with the highest olein content and the lowest melting point were those made up largely of beans or consisting entirely of corn meal.

In the second series of experiments the best results came from a grain ration half of which was corn meal, the other half being a mixture of equal parts of oats, pease, and barley, with skim milk and sugar beets in addition. A ration of pease alone gave nearly as good results. The poorest results came from corn meal alone and beans alone.

In this series of experiments and in the work of Day at Guelph the effect of skim milk was strikingly shown. One of the best lots of bacon in the second series at Ottawa was fed on a ration of corn meal and skim milk. This shows that the American farmer has it in his power to produce a grade of bacon which will be unsurpassed. In those sections of the country where corn can not be produced, but where barley is an abundant crop, he has the best bacon-producing grain known. In the corn belt, where the most abundant crops of corn are at his command, he can neutralize the injurious effects of this grain on the carcass by the use of skim milk.

It is not idle fancy to urge American farmers to consider the tastes which the Englishman wishes to gratify in regard to the bacon he buys. The American bacon commands the English market by reason of its overwhelming quantity, not by its quality. It is entirely outclassed by the Danish bacon and sells below the Canadian product.

During the fifteen years for which we have figures regarding Danish bacon the valuation per 100 pounds has been less than $11 in three years only (1895, 1896, and 1899), and in one year only (1896) has it fallen below $10, when a valuation of $9.93 was reached. In the years

1893 and 1901 it was more than $13. On the other hand, in the years 1893, 1901, and 1902 only has bacon from the United States had a valuation of more than $9 per 100 pounds, and in the years 1893 and 1902 only, when extremely high prices were recorded in this country for live hogs, has the valuation been in the neighborhood of $11 per 100 pounds, being $11.02 and $10.90, respectively, in these years. In no year has it sold up to the average valuation per 100 pounds of the total imports of bacon into the United Kingdom. In three years—1888, 1893, and 1902, all years of high prices in this country—the difference in value per 100 pounds between Danish and United States bacon has been less than $2.50, as follows: 1888, $2.48; 1893, $2.09; 1902, $2.07. In 1895 the difference was less than $3.50, but in all other years it was more than $3.50, a difference of more than $4 being noticed in the years 1889, 1890, 1891, 1892, 1897, and 1898, and a difference of over $5 in the years 1890 and 1897. The greatest difference was in 1890, when the Danish bacon averaged $5.20 per 100 pounds more than that from this country. The average valuation per 100 pounds of all bacon imported into the United Kingdom for the entire period from 1888 to 1902 was $8.94; that of the United States bacon was $8.07, and that of the Danish bacon $11.83, a difference of $3.76 in favor of the Danish bacon.

Further evidence of the fact that Danish bacon stands higher in the esteem of the English people than that produced in the United States is that there is less fluctuation in its value on that market in periods of greatest supply. In other words, when a shortage in the American supply sends prices up and diminishes exports from this country, the price of the Danish bacon, while rising somewhat, does not increase in so great a proportion as that from the United States. On the other hand, when supplies increase in this country, causing prices to fall and exports to increase, the American product decreases in price on the English market to a greater extent than the Danish. The Danish bacon therefore seems to supply a trade that buys it more steadily, and, to a certain extent, regardless of price, whereas the American product goes to the trade which buys it in largest amount when the price is low and curtails purchases when the price rises.

THE EFFECT OF HOG RAISING ON THE FERTILITY OF THE LAND.

The Arkansas Station[a] noted the effect which the grazing of pigs and the growth of leguminous crops had on the soil and the cotton yield per acre. Cotton was grown on plats where pigs had grazed peanuts, chufas, or soy beans, and a fourth plat, which had been in corn which had been cut and the stover removed therefrom, was used

[a] Bul. No. 68.

as a check. The yields of seed cotton per acre were as follows: On the peanut-grazed plat, 1,771 pounds; on the chufa-grazed plat, 1,200 pounds; on the soy bean-grazed plat, 1,588 pounds; on the corn plat, 1,005 pounds. During the succeeding year the cotton yield was noted on the same plats, no fertilizers having been applied. Some decrease of yield was caused by unfavorable climatic conditions. The yields were: On the peanut-grazed plat, 1,134 pounds; on the chufa-grazed plat, 981 pounds; on the soy bean-grazed plat, 1,020 pounds; on the corn plat, 798 pounds.

These figures show that during the first year after grazing on peanuts, soy beans, and chufas the manure left by the pigs, supplemented by the fertilizing properties of the plants themselves, increased the yield of seed cotton from nearly 20 to more than 76 per cent per acre over the yield from a plat where corn had been grown; and that during the second year the yield in favor of the grazed plats was still apparent, ranging from over 22 per cent to over 42 per cent more on the grazed than on the ungrazed plats. Naturally some of the increased yield must be attributed to the fertilizing value of the peanuts and soy beans, but as chufas are not leguminous plants, and therefore are not equipped with nitrogen-gathering bacteria, the figures, where they were used, show quite accurately the manurial effect of the grazing. The increased yield on the chufa-grazed plats was nearly 20 per cent the first year after grazing and over 22 per cent the second year after.

The Tennessee Station[a] calculated the value of the manure made by pigs in experiments at Knoxville. In the experiments of 1902–03 the available manure was estimated at 75 per cent of the excrement voided by the animals, and its value was calculated by estimating nitrogen at 15 cents per pound, potash at 5 cents, and phosphoric acid at 5 cents.

The following table shows the estimated value of the manure made. There were 3 pigs in each lot in the tests of 1902 and 4 in each lot in 1903. They were fed sixty days in 1902 and seventy-seven days in 1903.

Value of manure in pig feeding.

Ration.	Value of manure.
Wheat meal, corn meal, and skim milk	$3.43
Wheat meal, corn meal, and skim milk	4.34
Wheat meal, corn meal, and skim milk	5.00
Wheat meal, corn meal, and skim milk	5.23
Wheat meal, corn meal, and skim milk	4.18
Soy-bean meal, corn meal, and skim milk	4.91
Corn meal and skim milk	4.04
Corn meal	1.20

[a] Vol. XVI, Bul. No. 3.

The high fertilizing value of rations composed to a considerable extent of nitrogenous feeds, such as the skim-milk rations and the soy-bean-meal ration, is apparent.

The value of manure as a by-product of animal husbandry can not be too strongly emphasized, especially in those sections of the country, like the South, where the fertility of the land has, to a certain extent, been lost. The South supports the greater part of the business of the country in commercial fertilizers, and, while paying enormous sums annually in this manner, can not look forward to anything but greater impoverishment of the soil unless the production of live stock is increased and the manure carefully utilized.

GROWTH OF THE CATTLE INDUSTRY OF CUBA.

By Ignacio Diaz Lopez,

Chief of the Department of Claims in the Customs Division of the Treasury Department of Cuba.

The law regulating the importation of cattle into Cuba admits free of duty cows for breeding purposes and their calves; also bulls of the following breeds: Jersey, Guernsey, Devon, Durham, and Hereford. These concessions were made to benefit our country and improve the cattle in our pastures.

The same law provides for the low duty of $2 (American money) per head on all thin cattle brought from certain countries into the Island to be fattened on its rich pastures, provided they do not exceed the following weights: Cattle from Florida exceeding 500 pounds must pay a duty of $5 per head, those from Honduras exceeding 600 pounds must pay $6 per head, those from Mexico exceeding 700 pounds must pay $7 per head, and those from Venezuela and Colombia and other countries not mentioned exceeding 800 pounds must pay $8 each per head.

The law prohibits the killing of thin cattle until fully three months shall have elapsed after their importation. At the time of their importation each animal must be branded with the date thereof in the following manner: 9–1–03—signifying the month, day, and year; whereupon they must also be registered and their pasture destination made known to the authorities. Before any cattle bearing this form of brand can be killed a permit from the proper authorities must be obtained and proof submitted that the stock has been in pasture the time specified by law. Failure to do this results in heavy fines upon detection.

It can not be denied that the long war resulted in the practical disappearance of the cattle in Cuba; the extensive and rich pastures of Santa Clara, Puerto Principe, and Santiago Provinces were deserted. The good effects of this law, however, early became apparent, for on December 31, 1901, according to the statistics of the treasury department, the following number of cattle existed in the respective Provinces:

Number of cattle in Cuba in 1901.

Province.	Males.	Females.
Habana	69,551	49,079
Pinar del Rio	59,984	23,738
Matanzas	51,456	29,000
Santa Clara	133,383	86,688
Puerto Principe	42,561	53,296
Santiago	57,680	32,937
Total	414,615	274,738

The same statistics show that on December 31, 1902, there existed, as registered in the official live-stock registers of the Island, 555,563 males and 444,299 females, or a total of 999,862 animals, which shows an increase of 316,509 head over the previous year. The total registrations in the Island during the year 1902 were 1,358,749 and the total withdrawals for the purpose of butchering or of driving into other districts were 1,048,240. This shows a discrepancy of 6,000 head, which small percentage is due to loss from sickness during the year.

The general consumption, by Provinces, for the years 1900, 1901, and 1902 was as follows:

Number and total weight of animals slaughtered for consumption in Cuba, 1900, 1901, and 1902.

Province.	1900.		1901.		1902.	
	Number.	Weight.	Number.	Weight.	Number.	Weight.
		Pounds.		*Pounds.*		*Pounds.*
Habana	98,975	36,121,527	96,864	37,169,818	96,177	37,720,705
Pinar del Rio	6,277	2,033,849	5,561	1,799,921	5,412	1,809,864
Matanzas	16,205	5,026,863	17,999	5,925,535	18,414	6,056,193
Santa Clara	26,764	9,600,124	28,156	10,550,366	28,599	11,190,966
Puerto Principe	7,677	2,283,806	8,910	2,857,047	11,133	4,125,233
Santiago	15,193	5,722,158	17,397	7,008,951	17,227	7,942,400
Total	171,091	60,788,327	174,887	65,311,638	176,962	68,845,361

The total number of head of cattle killed throughout the Island for the three past years were 171,071 in 1900, 174,887 in 1901, and 176,962 in 1902, with the following weights for the respective years: 60,788,329, 65,311,639, and 68,845,352 pounds.

The importation of cattle during the above-mentioned years was as follows: 1900, 288,324; 1901, 368,793; and 1902, 267,281 head. The importation of cattle from various countries for the fiscal year ended June 30, 1903, was as follows:

Number and value of cattle imported into Cuba, fiscal year 1902–3.

Country from which imported.	Number.	Value.
Mexico	121,659	$2,322,739
United States	57,201	917,112
Colombia	36,742	860,083
Honduras	19,414	390,189
Porto Rico	8,325	116,942
Venezuela	2,817	53,922
Costa Rica	1,620	75,513
Santo Domingo	1,376	47,362
English islands	769	26,305
Nicaragua	41	1,180
Total	252,964	4,861,347

Upon arrival in Cuban ports an inspection charge of 10 cents is made for each head. In Habana there is also a dockage charge of 12 cents per head.

The statistics above show that the cattle imported into Cuba from Costa Rica commanded the highest price, which was an average of $46.61 per head. Those from Santo Domingo come next in order at the price of $34.42 per head. The other countries which ship cattle to Cuba are the English West Indies with an average value of $34.21; Nicaragua, $28.78; Colombia, $23.41; Honduras, $20.09; Porto Rico, $20.05; Venezuela, $19.14; Mexico, $19.09, and the United States, $16.03.

With a population of 1,572,797, there were 176,962 head of cattle butchered in Cuba in 1902, averaging a fraction over 389 pounds (dressed), each, or a total of 68,845,352 pounds of beef for the year. The consumption of beef, therefore, was 43.07 pounds per capita for the year; the consumption of pork was 6.82 pounds per capita, while the consumption of mutton was but nine-tenths of a pound per 100 inhabitants.

The consumption of beef per 100 inhabitants, according to provinces, during the past year was as follows:

	Pounds.
Habana	4,010.5
Puerto Principe	2,125.1
Santa Clara	1,426.7
Matanzas	1,359.8
Santiago	1,101.1
Pinar del Rio	482.9

From these figures it is plain that the concentrated population in the cities largely governs the consumption of meat, the country people living mostly on vegetables.

By the above figures it will be plainly seen that the importations are on the decrease. The present conditions in Cuba have been completely changed by the building of the Cuba railroad, which now facilitates

the movement of the products of the richest zone of the Island; and the question now is, Will the central and eastern provinces continue to devote their energies to stock raising entirely, or to the cultivation of the fertile estates? Stock raising, before this railway ran through and united the interior of these provinces with the ports and other portions of the Island, was about the only pursuit the inhabitants living in those districts could engage in. Then all of the cattle were driven over the roads to the immense pastures. To-day this is not so, for with transportation facilities more economical methods of marketing cattle can be employed; new industries can also be profitably followed, sugar centrals can be established, fruit, cotton, and various other products planted, and a large percentage of the lands now used for pastures made to produce profitable crops.

Without doubt there will always be a large portion of Cuba's lands devoted to stock raising, and with the continuance of this industry, assisted by agriculture, the national resources will be enriched on all sides.

Notwithstanding that the population will steadily increase, it is probable that within a few years the production of cattle in Cuba will be sufficient for the home demand, if the protection of the industry is maintained as it should be.

In addition to the above it may be said that the law also prohibits the killing of cows, except when it is known and proven that they can not reproduce. This measure is one highly protective to the industry.

A PLAN FOR THE IMPROVEMENT OF AMERICAN BREEDING STOCK.

By George M. Rommel, B. S. A.,
Expert in Animal Husbandry, Bureau of Animal Industry.

The most striking features of agricultural progress at the present time are the intense study which agriculturists, botanists, and horticulturists are devoting to the subject of systematic and practical plant breeding and the very remarkable results which have been reached. New varieties of wheat have been evolved whose productiveness promises to add materially to the country's output of cereals; new varieties of cotton have been perfected; corn has been improved so that it will yield not only a larger amount of grain per acre but produce a higher percentage of protein than was contained in the original varieties, and the statement is now being made that it will probably be but a short time until the nitrogen-gathering bacteria will thrive on the roots of this plant. These achievements have increased directly the production of agricultural wealth.

The methods by which this great work has been inaugurated do not differ widely from those used by animal breeders, for the principles of heredity are undoubtedly the same whether applied to plants or to animals. Selection and pure breeding were potent methods in bringing about the results mentioned above. Both are at the basis of success in animal breeding and have been applied for generations. Both are fairly well understood by stockmen. The third agent, whose use has given tremendous impetus to plant breeding—crossing between varieties and hybridizing between species—is rarely resorted to in animal breeding except for the production of market animals; it is therefore a new field for exploration.

The situation at this time is that the breeders of plants have passed the breeders of animals in this line of work and to-day possess a better insight into the principles underlying their science. This difference can perhaps be ascribed to two causes: The first is that the breeding of animals has been so long a business of recognized standing that its principles are supposed to be established to a certain extent. It will come somewhat as a surprise to say that animal breeding, as a field for scientific investigation having useful purposes in view, is practically unexplored. On the other hand, the prospective investigator of animal breeding, filled with zeal for the study of his subject, has

been restrained by the tremendous difficulties in his path. With animals material is expensive, while with plants it is relatively cheap. With animals offspring are few in number, while with plants the production of thousands of individuals is the work of but a year or two. The animal breeder has heretofore had an advantage in the respect that winter months do not limit his operations, but the plant breeders are meeting their difficulties in this respect by conducting their work under glass.

A feeling is gaining ground that a study of animal breeding similar to that now devoted to plant breeding should be inaugurated. Animal breeders are beginning to note the influence of the activity of their brothers of the plant-breeding fraternity. In their opinion, if the importance of plant cultivation warrants the expenditure of a large amount of energy, thought, and money, the intimate relation of live-stock husbandry to successful agriculture, the magnitude of the live-stock business in the domestic and foreign trade of the country, and the dependence to a large degree of the nation's life and prosperity, directly or indirectly, on the animal industry, are reasons why so great an effort should be put forth by scientific men and by State and national governments to solve the problems of heredity from the standpoint of the stockman.

On general principles, we should raise the standard of our breeding stock, for it is axiomatic that where there is no progression there will be retrogression. Further evidence of the need for improvement may be found in the variety of types—the striking lack of uniformity—among the exhibits of the same breed that may be seen in any show ring of importance. This is due either to the lack of a well-understood ideal among breeders or to variations in their standards among judges. A breed can not effectively do its share in the improvement of the native stock until its promoters have a definite standard in view, and the breed which is most uniform in the type shown by its individuals will be the one to transmit its characteristics most when its blood is infused into that of native stock.

Another reason why American breeding stock needs improvement may be seen in the large influence exerted upon the stock-breeding interests by animals bred in foreign lands. If breeding animals can be brought into the country each year by the thousand and sold at a profit, and if home-bred animals compare unfavorably with those imported ones when they meet in the show ring, it certainly argues the need of improvement in American breeding stock.

Improved breeds have been established on American soil in two ways—(1) by careful selection among the best individuals of the native stock and pure breeding after the type became fixed, and (2) by direct importation of individuals of breeds already established in other countries and pure breeding from this source, using the foreign book of

record as the foundation of pedigrees. In some instances there have been exceptions to these general rules. Before registrations became extremely rigid in the United States the admission to record of an animal not directly traceable to foreign books was possible among some breeds which had a foreign origin; in other cases the beginning of importations and the establishment of a book of record in the United States preceded and eventually brought about the organization of breeders and the publication of a book of record in the country from which the importations came.

The immediate result of the first method has been the production of breeds of live stock peculiar to our soil and climate. It forced farmers and stockmen to use the material at hand and to build up from the foundation. It compelled them to select their own standards and fix their own types. It concentrated their attention on their own breeding pens, and did not befog their minds with the ideals and methods of breeders 3,000 miles away, under different soil and climatic conditions. It gave the country the American hog, the American trotter, the American saddle horse, the American hen, and the American turkey. It produced the Renick Rose of Sharon family of Shorthorns, and its influence may be seen at this time in the molding of type and form in the beef herds which crowd our show rings. The remote effect was that the breeders of such stock were independent of the influence of those in another country. They were not compelled to accept rules of entry to which they themselves objected and which they did not permit in their own books. Furthermore, it gave American breeders in general a greater pride in their work and greater incentive and called attention to the country's possibilities in stock breeding. Its weakness lay in the fact that, under conditions which have always seemed to require a closed registry, a smaller number of individuals in the breed caused a certain amount of danger from close breeding and precluded the wide range of selection which was possible when breeds were established from other countries. It was a slow and hard method of work. The experience of these breeders was a repetition of the work of the pioneers in England and Scotland, and in some cases the results may not have seemed commensurate with the effort put forth, but they are of permanent value.

The second method has had for its object the development of breeds by direct importations of animals already bred to a high degree of excellence in other countries. It has been the means of establishing the Thoroughbred horse, all our breeds of draft horses, several of coach horses, the leading breeds of beef and dairy cattle, numerous breeds of sheep, and at least three of hogs. While the former method developed breeds by the improvement of the native stock, this method transplanted breeds by importation. It has been the principal means of improvement of American stock.

The immediate results of the importation method are seen in the rapidity with which breeds have been established. In a word, the American importer seemed to begin where the foreign breeder stopped, and breeders in this country were thus saved many years of work. All things considered, the live-stock industry could not, perhaps, have been built up so rapidly without importations. The breeders of Europe had a very considerable start over those in the United States. Further, the system of county breeding, to which Professor Hayes calls special attention, had become a fixity in England long before Bakewell's time. To build up breeds in America in the same manner as had been done in England would require an amount of time and trouble which enterprising pioneers thought might as well be saved. Therefore breeding animals of all kinds were imported, and from the earliest days of the country's history, with the exception of four years only, animals imported for breeding purposes have passed the United States customs free of duty. There have been various modifications of this provision, and regulations are in force to control it, which it is not necessary to discuss here. It is the historic policy of the Government to encourage the introduction of animals from abroad whose use on native stock will improve the breed and not introduce disease. With such encouragement many thousands of animals have been brought to our shores. For a century, but particularly during the last twenty-five years, breeding animals have been sold on the Continent of Europe, in Great Britain, and in Canada for shipment to the United States. Not only have breeders themselves bought large numbers of animals abroad, but a class of men has sprung up, especially among horsemen, who make a business of importing breeding animals for sale simply and who rarely import, own, or breed a female. These animals, as a rule, are well-selected; their buyers are keen judges, and the stock of the country is generally benefited by their use. There is no purpose here to cast aspersions on the importer who conducts his business in an intelligent and honest manner; but is not the importing business somewhat anomalous? We have been importing Percheron horses plentifully for thirty years, and never have they come in larger numbers than at present, unless it was in the early days. Shorthorns began to come to the country early in the century; they have not come in steady numbers, it is true, for importations have varied with the activity of the beef-cattle trade, yet we still see Shorthorns imported, and such cattle still hold a prominent place in the show rings. These two instances are sufficient to illustrate the point. We imported in the past and we import at the present. Shall we always be dependent on the breeding farms of Europe? These animals have mainly gone to the breeding farms of the country and should have raised the standard of the breeding stock. One would think the home-bred stock should equal the foreign stock in time, if not, indeed, surpass it.

Not only does the importing method seem to have failed to fix type in many instances, but an idea has gained a foothold concerning the merit of imported animals which is at times almost a positive prejudice against home-bred stock. The man who desires to establish a breeding farm frequently endeavors to get as many imported animals as possible; and, say what we may, the word "imported" still has a charm for the best of us. The power of this word does not rest in the fact that the animal which it designates is superior in individual merit to those bred on native soil. It has acted as a charm—an ignis fatuus—and has clung to foreign animals since improvement began. It is the same delusion which makes us think that something from an adjoining county is better than the same kind of article from our own. It will induce us to pay a round price for an inferior razor if the words "made in Germany" are stamped on the heel. You will find boats on the creeks and rivers of Wisconsin which are made of Oregon pine, and there are boats in Oregon made of Wisconsin oak.

There is undoubtedly a superiority in some classes of the live stock of foreign countries. The consensus of opinion is that in Great Britain the general average is higher and the scrubs fewer in number than in America, but this does not prove that there are conditions in that country which peculiarly fit her for the production of breeding stock above all other countries, and a somewhat lower average here does not prove that conditions in the United States do not favor such production. The quality of foreign-bred animals, the favorable conditions of foreign soils and climate, and the ability of foreign breeders have been so continually held up to our gaze that we have come to regard our own as inferior.

There are other faults in the importing system far more serious than the prejudice which exists in its favor. In our eagerness to get the best productions of foreign breeders we have taken only the results; the methods of the old country have never really gained a foothold in our soil. The men whose names are so often mentioned as those whose efforts established breeds in Great Britain spent their lives with one breed. Not only that, but their fathers before them had begun the work. These men had their own ideals; they were persevering. Twenty, thirty, and fifty years of constant service has repeatedly been recorded in their favor. Yet, with a few brilliant exceptions, the history of stock breeding in this country can point to no such records. Further, American restrictions on breeding methods are much more rigid than those abroad. Fashions in pedigrees have altogether too much weight; color is too important. Col. W. A. Harris has recently said, speaking of Shorthorn breeding:

> It is unfortunate that we can not exercise the same liberty of action ourselves which we are perfectly willing to concede to the breeders in Scotland and elsewhere. They breed as they please, so far as pedigrees are concerned, and are judged fairly on the

result of their operations. If the animal produced is satisfactory, there is no criticism whatever made upon the methods pursued or the means adopted to produce the animal. Here we accept without a word of criticism all they produce, and we have no criticism to make upon the means by which they have arrived at the end; but we steadily deny ourselves equal freedom, and we are constantly neglecting and discarding material which is fully as good and which has been among us for years and which we should appreciate strictly according to its merits.

Even in methods of registration we countenance practices abroad which we absolutely prohibit among ourselves. The American Shorthorn Breeders' Association maintains what some have considered a radical position when it restricts the registration of imported animals to those tracing to ancestors recorded in the first twenty volumes of Coates's Herd Book. American breeders are afraid of the cattle from herds which have been built up from native stock and which, under certain conditions, are eligible to registry in the British herd book. This position of the Shorthorn Association is severe, but it is not nearly so unjust as that of associations which do not allow the registration of even a five-top cross in home-bred stock, but are ready to take without question animals recorded in foreign books whose pedigrees are so short that they do not fulfill the requirements of the Government for free entry through the customs. If it is wrong for breeders in this country to breed up from native sources by means of registered sires, it is unfair to allow the registration of a third-cross imported animal which, in addition, has passed the customs free of duty. Either our breeders should be allowed similar privileges or the foreign stock must meet the requirements of the American books for American-bred animals.

That it is possible to improve American breeding stock so that we shall be able to supply our own needs in this respect seems hardly open to question. The country has a foreign trade in meat products and horses to which it is unnecessary to call attention. These products show the possibilities of this country to produce high-class articles, and the question is submitted whether, if we can produce high-grade meat and horses, we can not also produce the breeding animals to supply the sires for our grade herds. The standards of the market animal apply with even more force to the pure-bred breeding animal, and when attributes are given breeding stock which the market does not recognize and which weaken rather than increase prepotency the individual merit of the breeding animal is diminished. The breeding animal himself must be either an individual of much merit, judged by market standards, or he must be able to transmit individual excellence to his offspring. In view of the high standard of most of our market products, can we deny the ability of our breeders to meet these requirements? The thing desired is possible if breeders will apply themselves to the task, and if our State and national authorities will study the problem, and the people lend their support and cooperation.

We can not always draw on foreign countries and obtain high-class animals. Indeed, the rate at which American importers have been buying abroad has caused alarm in those countries for fear that an irreparable loss will be suffered. Of horses, there are in the United Kingdom, in round numbers, 2,022,000 used for agriculture, including unbroken horses and breeding mares; in Belgium, 241,000; in France, 2,926,000; in Germany, 4,195,000. Of cattle, the United Kingdom has 11,376,000; Holland, 1,655,600. Of sheep, the United Kingdom has 30,056,000; France, 19,669,000; Germany, 9,692,000. Of hogs, the United Kingdom has 3,639,000. As only a small proportion of any of these breeds can be used for breeding purposes, the actual number of animals available for exportation to this country is small, especially when undesirable individuals are eliminated. In the United States there are approximately 18,000,000 horses, 67,000,000 cattle, 61,000,000 sheep, and 62,000,000 hogs. Russia only has more horses, and Argentina and Australia more sheep than the United States has, and no country has so many cattle and hogs. In these large numbers we have a positive advantage in the production of breeding animals.

The time is rapidly approaching when the efforts of scientific men must be directed toward the study of the abstract problems of heredity and their practical application to the animal industry. It is a work of great magnitude, in which both the laboratory investigator—the student of pure science—and the animal husbandry worker in the agricultural colleges—the student of applied science—must work in cooperation. One of the first necessities is the equipment of laboratories where breeding experiments can be carried on with the smaller animals which breed rapidly and are highly prolific. These laboratories should have every facility for the utmost freedom of study. They should be supplied with ample funds, and be under the charge of men whose positions are secure and whose ambitions will lead them to make this work a life study. As the results of such investigations might not always be available for the use of the practical stockman by reason of their technical nature, there should be breeding farms in the same localities as these laboratories, and operated in connection with them where the results obtained could be tested with larger animals under field conditions. These farms should be under the charge of men thoroughly trained in animal husbandry, using that phrase in the broader sense. They should be able to go into a strong show ring if necessary and fill creditably the positions of judges; they should know how to breed and feed the kinds of live stock under their care; and should be permitted to keep in touch with the practical side of the industry. At the same time, they should have sufficient scientific knowledge of the subject of animal breeding to enable them to work intelligently and in sympathy with the laboratory investigators. In view of the diversity of soil and climate of the country this work

would have a source of weakness unless the central breeding establishment were in close communication with the different sections of the country where the animal industry is a feature of agriculture. This communication can best be maintained by means of branch breeding farms, operated under the auspices of the central authority or in close cooperation with it. The effects of soil and climate could thus be noted accurately.

No plan of operation would be complete unless it embraced the investigation of herd books and the collection of statistical data showing accurately the breeding records of animals of prominence in the different breeds. It entails, also, cooperation between breeders' associations and investigators, and the organization of county associations of breeders which will have for their purpose the production of results similar to those obtained in Great Britain. The great success of the English system of county breeders, where a sort of mutual consent and mutual liking for the same animals led men to work with the same breeds, is an indication of what may be expected in the United States by systematic and extensive cooperation and well-directed unity of action among neighbors.

Another necessity requires the fullest dissemination of the results accomplished—the discoveries made and principles evolved. The successful plan must of necessity be an educational one. It must show the weakness of present methods as well as their strength, the advantages and disadvantages of the country's facilities, the points to be gained by the concentration of our own blood lines, and the occasion when it may be necessary to go abroad for new blood or for new types.

The keystone of this plan would be American blood, purebred, and recorded by preference, but native if necessary. The best of the blood lines which we have at present, which have been brought from abroad or evolved on our own soil, would be studied, blended, and perfected. It would be folly to restrict the work solely to the use of blood lines or animals to be found within the boundaries of the United States. Rational importing has too firm a foothold on the country and means too much to the live-stock industry to be lightly thrown aside. Under the proposed plan importations would have to be made, and should be encouraged if the animal to be imported was of superlative excellence and its breeding that which would blend well with the best of our own stock. The importation of inferior animals, however, which have been purchased solely with the profit of the importer in view, and may not even be bred as represented and which are sold by highly reprehensible methods, should be discouraged by every means.

A very important and hitherto undeveloped field of work for the promoters of such a plan would be the introduction of new breeds of live stock. There are a great many opportunities in this respect which, if properly utilized, might give the country new breeds of

value. For example, Highland cattle might be tried on the mountain pastures of the Appalachians, where no danger would need to be apprehended to forests, and on the lower slopes of the Rocky Mountains. Some of these cattle have been imported, but there is little information available which can guide the public to a proper estimate of their value under American conditions. A recent importation which attracted considerable attention in the East was one of Welsh Mountain sheep, a very useful breed in its native hills, but never before imported into this country. The animals recently imported show considerable adaptation to their new environment. One of the most promising animals for introduction at present is the milch goat. As is well known, goat's milk is very highly appreciated by physicians for infants and invalids, and the animals are very highly resistant to tuberculosis. Further, the goat is an easy keeper, and those of the European countries yield from 2 to 4 quarts daily during lactation. Under such conditions the development of a breed of deep-milking goats would add a highly desirable product to the milk supply, and would be a boon to the poor of the cities who can not afford to keep a cow, but could keep a goat. The goats now in the United States are not generally desirable for dairy purposes, although some very good work has been done in breeding up from the common goat by selection. The work of developing this industry can be given great impetus by the introduction of the best varieties of Europe. Indeed, an agent representing various private interests has recently been to the Continent to make purchases of milch goats, and others may follow. An animal which has never been introduced into the country extensively, but whose use has been suggested on the Rocky Mountains, is the alpaca of South America.

The introduction of new breeds or species should not be permitted to get into the hands of unscrupulous promoters. When untried animals are introduced they should not be used for general breeding purposes until they are given a thorough test. The public should then know the exact truth concerning them and should be given an accurate estimate of their value, showing their weak and strong points and to what sections of the country they are adapted.

It has been suggested that the Department of Agriculture, through the Bureau of Animal Industry, lead in the work of instituting the systematic and comprehensive study of animal breeding, in cooperation with the State experiment stations and the breeders' associations. How far this may be carried out and the manner of its execution can not be stated at present. During the past year the Department has exercised a closer system than formerly in its work of certifying herd-book associations to the Secretary of the Treasury under the tariff laws, and a systematic plan for the performance of this duty is now under consideration which will go far toward eliminating loose and

questionable practices from the affairs of those associations which may not be conducted honestly and which will not work hardship or offend the self-respect of those whose administration is upright and straightforward, but will be in a sense a guaranty that they are worthy the respect and confidence of the public.

Investigations in animal breeding may properly come under the domain of the Department of Agriculture. The field of nutrition and feeding is influenced more by local conditions. It has been pretty thoroughly covered by the State experiment stations, and does not entail so great an expense as animal breeding. Animal breeding, on the other hand, is apparently more general in its application. It has not yet received much attention from the experiment stations, and to accomplish valuable results it will require resources which few of these institutions can command. If, in the opinion of the leaders in the industry, the time is ripe for such a departure and a feasible plan is formulated, it is possible that in the near future the work of the Bureau of Animal Industry may be enlarged to include investigations in animal breeding.

There is no lack of room for investigators to work. The field is new and it will be sometime before it is crowded. There are opportunities with every kind of stock. The development of the draft horse in the United States, by which American breeders could supply the American demand for stallions, and the development of the heavy-harness horse, the hunter, the polo pony, and the cavalry horse are subjects which interest the horseman. The development of a true dual-purpose cow, the elimination of the scrub in general, and the reason for the numerous representation of foreign herds in our show rings claim the cattleman's attention to the movement for the improvement in animal breeding. Sheepmen are interested in the study of the range conditions. The development of an American bacon which will have a better standing and a higher sale abroad is a matter of importance to hog raisers; and the possibilities in poultry breeding are no less attractive.

Improvement means more, however, than merely supplying the home demand for breeding animals. It defines itself; it means a more economical carcass, more efficient work, greater speed, beauty and general usefulness, and higher prepotency and fertility in our breeding stock. It has a direct influence on the income of the producer, and the welfare of the country at large is reciprocally affected.

INFORMATION CONCERNING COMMON GOATS.[a]

By George Fayette Thompson, M. S.,
Editor Bureau of Animal Industry.

THE PURPOSE OF THIS ARTICLE.

For several years numerous inquiries have been coming to the Bureau of Animal Industry as to the possibilities of raising goats for their skins. These inquiries are principally from those who have capital for investment or who have large tracts of unproductive land. When these people become aware of the fact that we send abroad $25,000,000 annually for goatskins, and that the natural conditions here are favorable for raising the goats which produce such skins as we import, they become interested. The press has encouraged the development of a domestic industry in the production of goatskins, oftentimes in ignorance of the conditions that obtain here and of those conditions requisite for success. It is in order to reply to these inquiries fully and accurately that this article is prepared.

MEANING OF THE TERM "COMMON GOATS."

It is not intended by the use of the term "common goats" to convey the impression that they are a distinctive breed. On the contrary, it is generally accepted as including all sorts of mongrel goats, whatever their size, conformation, color, or character of hair. They are usually referred to as "common" in order to distinguish them from the Angora goats, which are a specific breed.

NUMBER AND VALUE OF GOATS.

The table given herewith is compiled from the census returns and shows the number of goats, of all kinds, for the year 1900. Besides the exhibit in the table there were 78,353 goats reported for cities and villages, making the grand total of 1,949,605 for the whole country.

It is a matter to be regretted that the census returns made no distinction between common goats and Angoras. A free estimate is that about 700,000 of the total are of the Angora breed. The rest are all sorts of animals except recognized breeds of milch goats, of which there are so few as not to affect the total materially.

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[a] Published also as Circular No. 42, Bureau of Animal Industry.

Number and value of goats, all breeds, on farms in the United States, by States and Territories, in 1900.

State or Territory.	Number of farms reporting.	Number.	Value.
Alabama	8,633	117,413	$94,258
Arizona	436	98,403	167,863
Arkansas	4,571	51,839	58,788
California	1,579	109,021	262,981
Colorado	620	37,433	73,141
Connecticut	73	313	1,945
Delaware	43	143	519
District of Columbia	6	9	39
Florida	2,154	43,705	32,639
Georgia	6,716	84,624	61,972
Hawaii	19	653	731
Idaho	68	4,481	20,167
Illinois	1,642	8,877	19,932
Indiana	1,518	4,484	8,920
Indian Territory	733	10,529	21,538
Iowa	3,007	41,468	146,708
Kansas	995	18,288	71,290
Kentucky	2,144	11,967	19,753
Louisiana	2,723	38,308	35,697
Maine	70	279	1,091
Maryland	227	1,179	4,023
Massachusetts	145	1,254	7,188
Michigan	537	2,861	10,008
Minnesota	498	3,821	12,908
Mississippi	5,431	55,388	45,594
Missouri	2,754	24,487	64,786
Montana	61	1,713	7,870
Nebraska	488	2,399	9,126
Nevada	39	4,633	12,948
New Hampshire	61	208	916
New Jersey	200	699	3,006
New Mexico	2,874	224,136	472,961
New York	576	1,316	6,442
North Carolina	5,089	42,901	37,997
North Dakota	142	1,122	5,308
Ohio	1,025	5,432	16,975
Oklahoma	277	3,772	10,854
Oregon	2,178	109,661	375,229
Pennsylvania	763	2,197	8,951
Rhode Island	16	23	131
South Carolina	3,643	26,576	24,450
South Dakota	252	2,915	15,050
Tennessee	3,663	25,884	38,938
Texas	6,742	627,333	923,777
Utah	93	1,427	2,702
Vermont	41	102	444
Virginia	1,004	5,305	10,002
Washington	165	2,876	10,757
West Virginia	219	847	2,123
Wisconsin	534	3,882	12,760
Wyoming	47	2,666	11,884
Total	77,534	1,871,252	3,266,080

So little is generally known about the common goat in this country, and it has heretofore been so little in evidence in public print, that no little surprise was expressed when the census returns showed an enumeration of about 2,000,000. Indeed, there are some who are inclined to doubt the accuracy of the census count. The writer, however, knows of no other way to form an estimate.

CONCERNING THE SUPPLY OF GOATS.

One of the principal inquiries made of the Bureau of Animal Industry is "Where can common goats be purchased?" This is a question we have been unable to answer except in a general and somewhat unsatisfactory way. It is known that in Texas, New Mexico, and Arizona there are considerable numbers of the long-haired variety, but it has been pointed out elsewhere that these are not suitable for the production of skins, and there are several good reasons why they are not suitable in any degree as foundation stock for a flock of Angoras.

While the census returns show a considerable number of goats of all breeds in most of the Southern States, they are extensively dispersed upon the farms. For instance, the 117,413 goats shown for Alabama were reported from 8,633 farms, the 84,624 in Georgia were on 6,716 farms, and so on at a similar ratio for the other States. In considering these figures we must not overlook the fact that in some of the States there are large numbers of the Angora breed. This is especially true of Texas, New Mexico, Arizona, California, and Oregon.

The common goats are found principally on the farms of the South which are tenanted by colored people and the poorer classes of whites, and for some of these the goats furnish about the only meat supply. The prices demanded are very low, but a few only could be found on one farm, and there would therefore be some difficulty in bringing any considerable number together at small cost.

KIND OF SKINS IN DEMAND.

Not all kinds of goatskins are in demand for leather. The skin of the Angora, for instance, is not at all suitable for shoe leather or for kid gloves, although tanners make of it morocco leather, and it is used to a considerable extent in the manufacture of workingmen's gloves. A prominent Philadelphia dealer in goatskins says: "The pelt of the Angora, whether it be from Turkey or elsewhere, is, as a rule, too thin and poor for leather, as it is a fact that the longer the hair of the goat the thinner and poorer the pelt." This being true, not only are Angoras put out of consideration, but also all goats having long hair. This eliminates a very large number of the goats of the United States, as no doubt our common goats are principally of the long-haired Mexican variety. One who contemplates raising goats for their skins should therefore not consider the Angora or any other long-haired variety.

Not all of the imported skins are suitable for shoe leather, but the tanner carefully sorts each bale and throws out all that have long hair, as that is conclusive evidence of inferiority.

Among the French mountaineers the raising of kids for their skins is a leading industry. Softness, delicacy of texture, and freedom from blemish are principal factors in the value of kid skins, and to secure these essentials great pains are taken. So soon as the kids are old enough to eat grass or other vegetation the skin declines in quality, as with such diet the skin begins to grow coarser and harder in texture, and thus its chief merit disappears. The kid is therefore carefully penned, not only to prevent it from eating grass, but also to secure the skin from accidental injury from scratches and bruises, which necessarily impair its value. When the kids have reached a certain age, at which the skins are in the best condition for the use of the glover, they are killed, and the hides are sold to traveling hawkers, through whom they reach the great centers of the tanning industry. The conditions in the United States, especially as regards the item of labor, are so unlike those of mountainous France that it is not at all probable that a similar industry could be maintained here.

IMPORTS OF GOATSKINS.

The table herewith, which shows the quantity and value of importations of goatskins for the fiscal years ended June 30, 1898 to 1902, is compiled from "Commerce and Navigation" of the Bureau of Statistics of the Treasury Department. The volume for 1903 is not yet available, but the Monthly Summary of Commerce and Finance for 1903 shows that the total weight of imported goatskins was 84,821,594 pounds, valued at $24,928,729. It is safe to assume that these skins came from the same countries that sent skins during previous years. These figures do not equal those of 1902 by 3,216,922 pounds and $549,450. It will be observed, however, that the general trend of imports has been upward, from about $16,000,000 in 1898 to $25,000,000 in 1903.

The British East Indies send us more goatskins than any other country, the value for 1902 being $7,577,616; then for the same year, in the order named, come France ($2,611,880), Mexico ($2,081,697), Chinese Empire ($1,823,273), Russia on the Baltic and White seas ($1,532,740), Brazil ($1,495,358), United Kingdom ($1,138,646), Aden ($1,094,367), Argentina ($1,055,040), and so on.

The values of these goatskins are those at ports of export. The average value per pound for the several years shown in the table is as follows:

	Cents.
1898	24.3
1899	26.5
1900	26.8
1901	27.9
1902	28.9

Imports of goatskins for fiscal years of 1898 to 1902, and countries of export.

Country of export.	1898.		1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
EUROPE.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
Austria-Hungary	1,340,898	329,906	956,656	271,379	1,322,840	367,221	1,211,241	329,245	1,313,191	399,916
Azores, and Madeira Islands	18,600	4,490			14,161	4,177				
Belgium	43,811	10,165	156,556	52,449	101,856	35,294	156,268	47,977	157,592	36,720
Denmark			20,190	2,979	96,495	22,232	450	107	95	20
France	8,685,397	2,164,570	7,894,102	2,268,146	9,568,071	2,809,291	8,866,780	2,608,751	8,813,030	2,611,883
Germany	2,283,384	691,064	2,860,288	926,734	2,257,614	713,807	3,181,697	908,948	2,621,322	752,850
Gibraltar			5,930	1,532						
Greece					34,986	9,549	22,086	5,162	20,270	4,065
Italy	795,028	177,908	726,515	169,224	510,341	133,550	627,944	164,752	474,934	147,498
Malta, Gozo, etc	37,527	11,659	33,531	8,023	35,688	8,440	43,009	11,402	49,393	13,040
Netherlands	414,753	152,954	335,701	137,763	466,104	235,931	405,852	230,708	462,751	265,268
Portugal	100,342	30,949	168,397	57,569	152,595	59,838	490,401	197,012	377,608	181,161
Russia on Baltic and White Seas	5,743,751	1,113,030	5,067,576	942,227	5,908,613	1,269,498	5,271,530	1,066,824	6,646,663	1,532,740
Russia on Black Sea	238,533	49,915	115,203	21,451	37,254	12,459	21,342	3,313	288,315	54,162
Servia	56,184	12,095					13,965	6,121	43,714	19,642
Spain	650,141	196,153	415,356	189,898	826,038	352,461	528,807	214,889	459,257	203,946
Sweden and Norway	26,164	8,467	27,761	8,725	61,446	16,511	71,786	30,310		
Switzerland	17,666	5,743	46,287	13,340	21,684	6,340	42,943	10,338	12,790	3,783
Turkey in Europe	1,879,315	457,304	1,695,921	367,103	2,247,562	413,843	2,464,712	503,648	2,455,768	621,556
United Kingdom	4,877,477	971,682	5,738,755	1,123,073	6,641,601	1,428,855	4,859,936	1,034,448	5,164,126	1,138,648
NORTH AMERICA.										
Dominion of Canada:										
Nova Scotia, New Brunswick, etc			24	10			1,430	189	790	315
Quebec, Ontario, Manitoba, etc	34,672	6,223	154,330	30,660	30,100	10,102	108,060	20,885	39,824	9,134
British Columbia			1,372	96					7	5
Newfoundland and Labrador									948	140

Central American States:										
Costa Rica	148	67	342	86	27,588	12,614	41	6	....	....
Guatemala	1,176	217	21,363	6,473	13,687	3,315	539	172	13,345	2,262
Honduras	....	....	....	....	36,847	12,362	6,483	2,017	....	....
Nicaragua	1,420	350	2,884	721	....	....	....	....	....	....
Mexico	3,857,677	1,021,200	4,261,679	1,198,066	4,352,127	1,409,054	4,882,418	1,625,157	6,179,804	2,081,697
West Indies:										
British	72,147	16,460	77,439	17,985	82,581	23,373	76,207	23,354	115,643	42,415
Cuba	295	86	....	....	....	....	468	72	....	....
Danish	5,489	1,470	4,863	1,349	4,876	1,065	5,489	1,142	5,542	1,360
Dutch	134,671	35,178	150,792	37,951	392,390	115,185	412,421	113,109	328,603	92,674
French	67,215	11,821	7,572	1,939	....	....	....	....	200	60
Haiti	127,361	37,271	224,495	74,088	314,839	116,986	227,947	79,108	225,822	70,266
Santo Domingo	100,669	29,292	122,805	32,813	118,953	40,508	117,219	43,359	226,655	65,913
Porto Rico	....	....	....	....	583	114	....	....	....	....
SOUTH AMERICA.										
Argentina	2,413,550	738,762	2,881,853	824,509	3,385,666	852,322	2,341,447	750,024	2,969,061	1,055,040
Brazil	3,643,916	1,563,346	4,386,337	2,177,960	2,400,742	1,234,018	2,751,204	1,530,420	2,554,092	1,495,358
Chile	84,381	17,835	141,751	21,900	211,245	50,053	257,603	59,876	166,069	40,685
Colombia	358,635	83,907	386,522	85,151	168,554	45,597	135,174	37,632	197,917	45,542
Ecuador	31,426	8,133	46,617	7,849	91,613	25,355	9,890	2,168	31,728	9,536
Guiana:										
British	....	....	1,350	350	....	....	....	....	....	....
Dutch	....	....	5,309	1,524	5,151	1,260	....	....	....	....
French	....	....	18,626	3,084	....	....	....	....	....	....
Peru	613,078	144,615	750,963	192,861	578,219	167,351	659,171	191,762	760,833	228,592
Uruguay	....	....	....	....	....	....	53,035	19,060	....	....
Venezuela	1,399,897	391,326	1,699,711	482,584	1,565,879	476,618	1,675,412	501,952	1,339,576	412,275
ASIA.										
Aden	4,243,869	927,438	4,614,444	1,178,528	3,004,090	920,721	3,029,894	909,426	3,336,843	1,094,367
Chinese Empire	4,070,737	714,668	4,324,668	868,336	5,014,173	1,186,753	3,351,987	706,238	7,619,062	1,823,273
East Indies:										
British	10,194,690	2,526,749	13,075,029	3,386,554	22,277,999	5,598,937	20,801,114	5,474,103	27,271,644	7,577,616
Dutch	165,371	49,632	261,575	88,467	538,171	239,426	449,479	202,357	338,042	182,490
French	....	....	....	....	....	....	....	....	8,600	3,019

Imports of goatskins for fiscal years of 1898 to 1902, and countries of export—Continued.

County of export.	1898.		1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
Japan					870	124	34, 181	7, 982	56, 181	13, 917
Russia, Asiatic									34, 888	8, 405
Turkey in Asia	321, 897	46, 597	193, 543	41, 863	506, 680	86, 323	221, 333	50, 798	423, 373	99, 280
All other Asia			39, 290	11, 446	84, 856	21, 644	349, 245	96, 392	577, 093	170, 383
OCEANIA.										
British Australasia	290	45	38, 530	12, 049	203, 947	64, 704	295	94	2, 788	768
Hawaiian Islands	13, 100	2, 891	11, 556	2, 906	7, 841	1, 578				
AFRICA.										
British Africa:										
South	713, 800	96, 908	594, 608	102, 288	621, 231	111, 005	514, 819	90, 532	629, 684	100, 927
East							247, 014	51, 223	143, 137	31, 753
French Africa	2, 114, 592	427, 536	2, 548, 147	521, 451	1, 925, 159	471, 326	1, 312, 368	303, 887	1, 362, 347	337, 019
Portuguese Africa	64, 958	14, 995	40, 727	11, 017	68, 008	14, 521	5, 050	806	51, 188	17, 000
Spanish Africa					3, 540	750	28, 002	5, 387	19, 657	3, 778
Turkey in Africa:										
Egypt	129, 718	25, 785	173, 162	50, 444	361, 797	87, 021	193, 612	49, 059	84, 107	22, 557
Tripoli					117, 983	24, 531	8, 391	1, 731	44, 263	11, 569
Canary Islands							9, 917	1, 817		
All other Africa	2, 733, 671	474, 744	2, 199, 942	451, 361	3, 148, 884	661, 761	1, 186, 488	249, 782	1, 518, 341	339, 891
Total	64, 923, 487	15, 776, 601	69, 728, 945	18, 488, 326	81, 998, 818	21, 987, 674	73, 745, 596	20, 577, 033	88, 038, 516	25, 478, 179

MARKETS FOR GOATSKINS.

The fact that this country imported goatskins last year to the amount of $25,000,000 is sufficient evidence that we have a market for any that might be produced, provided the domestic skins were suitable. Of this point there can hardly be a doubt; but it is not probable that those who might engage in the industry here would take the pains necessary to produce the best skins. Those that are imported go principally into the manufacture of shoes, although large quantities are made into gloves and a lesser quantity into morocco leather.

As there has not been a sufficient number of domestic skins placed upon the market to establish a price, the only estimate that can be made must be based upon the imported skins. In making such an estimate it should be remembered that the values of imports are the invoice prices at ports of export, and also that the skins are all dry. With these figures as a basis, it will be seen that the skins received in 1902 were worth an average price of 28.9 cents per pound; in 1901 the average price was 1 cent per pound less. Of course, the weights of the skins vary considerably between the light kid skin and the heavier one of the mature goat. It is a very heavy skin that will weigh 4 pounds when dry. But the value of a properly preserved kid skin is greater per pound than that of an old skin. In estimating an average, one would have to consider these points as well as the supply and demand.

Most of the imported skins arrive in bales of 100 each, and they are all dry. These are sorted into grades by the tanner, and this selection, with his further manipulation, adds to the value.

THEIR MEAT AND THE MARKETS FOR IT.

While it is generally agreed among those who speak from experience that the kids of all breeds of goats are a delicacy, it is true that among the great mass of the people of this country there is a prejudice against anything bearing the name of "goat." Within the environments of all of the larger cities are found many kids, and it is evident that only a few of them grow to maturity. What becomes of them? Butchers and meat dealers answer the question by saying that they pass over their blocks as "lamb." No meat dealer has heard of a complaint of the quality of such "lamb."

A considerable number of mature common goats are purchased by the packing houses of the larger cities. They are purchased as goats and sold, either in the carcass or canned, as mutton; and many who decry goat meat have unconsciously eaten it many times no doubt. This does not mean that the meat is as palatable as good mutton, but it may be as good as poor mutton, and so the consumer's criticism concerns the quality and not the kind.

The flesh of any mature common goat is not palatable to most persons who have tasted it. This is due to the strong taste and, to some extent, to its toughness. Proper care in dressing would probably mitigate if not entirely prevent the strong taste, and feeding on grain would tend to produce a more tender carcass. Both these points, however, will hardly receive attention from anyone who may contemplate going into the industry, for the reason that they will add materially to the cost of production.

The excellent quality of the kid meat has already been mentioned. It is safe to say that the existing prejudice against it would disappear if people were to test it, and in time a good market ought to be built up for all that can be produced. However, the question arises, Will it pay to raise common goats for the sale of kids? The farmer will have to determine this matter for himself. If a ready market were established for the kids at, say, $1.50 each, and if one doe can raise three or four kids annually, it can hardly be doubted that the industry could be made profitable. At this time no such market exists.

LAND AVAILABLE FOR GOAT RAISING.

In a general way it may be said that all land in the United States, except the very low and swampy tracts, is suitable for goat raising. The feed that goats prefer is browse, with a small admixture of weeds and grass, and therefore those tracts of land that are burdened with brushwood and briers are especially desirable. This fact makes it clear that in the colder parts of the country it would be necessary to provide some feed in winter, as nothing but the soft twigs remain at that time as browse. Goats will eat grass if required to do so and will thrive upon it, but grass land is regarded as being so much more profitable for hay production or as pasture for cattle and sheep that the placing of goats upon it is not to be considered.

There are millions of acres of land suitable for goat raising in the United States. Some of it is Government land open for settlement, and much of it is held by private ownership. The Bureau of Animal Industry makes no pretentions toward locating this land for inquirers, but must direct them to other well-known sources of information, such as the various Government land offices, State boards of agriculture, industrial agents of the railroads, real estate agents, etc.

If one selects land for raising goats for their skins in the cold climates, he must remember that he is dealing with short-haired animals, and therefore he must provide a warm shelter for them for winter use. Where the Angora revels in the dry cold of a severe winter, the common short-haired animal would freeze to death.

AS FOUNDATION STOCK FOR ANGORAS.

A few years ago Mexican does were used extensively as foundation stock for a flock of Angoras, using bucks of the latter breed. How-

ever wise the practice may have been at the time, that method of building up a flock of fleece-bearing goats is now in vogue but slightly, if at all. The practice flourished best when the goat raisers knew very little of the larger prices they might have obtained for a better grade of mohair. They were content with prices ranging from 14 to 22 cents per pound. Manufacturers have required better hair than can be produced by grades, and this has tended to reduce very greatly the number of crosses.

CROSSING COMMON GOATS AND ANGORAS.

The employment of common does as foundation stock for a flock of Angoras has already been discussed, and the practice is not encouraged. Considered from the standpoint of meat production, however, the practice merits some favor. While the flesh of the mature common goat is quite inferior, it is well known that that of the Angora is most excellent, and the predominating influence of the Angora blood is so pronounced in crosses that these partake in large degree of the toothsome qualities of the high-grade Angoras.

The question of profit in the production of such crosses for meat will depend upon several conditions which are not easy to find in combination. If it were possible to obtain any considerable number of does easily and cheaply; and if they could be maintained at low cost of feed and care, and, finally, if there could be found a steady market for the produce, the business could be made profitable by good management. The fact that the packing houses buy goats now at a price slightly lower per pound than they pay for sheep leads to the belief that there would be no difficulty in finding a market for the meat; but it must be remembered, as has been stated elsewhere, that this crossing will ruin the skins for any sort of manufacture except for workingmen's gloves and morocco. The packer who buys the goats knows this as well as anyone, and he pays a lower price accordingly. Therefore in the matter of crossing to improve the quality of the carcass the salable quality of the skin has been very much impaired.

AS DESTROYERS OF BRUSHWOOD.

The pronounced characteristic of Angora goats for destroying brushwood, briers, weeds, etc., has been exploited so extensively that many people have received the impression that this is a characteristic peculiar to the Angora breed. This is not the fact, however, for the predilection of goats for such a diet is common to all breeds alike. Therefore the question that is often submitted to the Bureau of Animal Industry as to whether common goats may be employed for clearing land as successfully as Angoras is answered affirmatively.

It is nearly always the case that land which is brush ridden is rich in quality, and when cleared is most excellent for natural grasses or for

tillage. To clear this land by ordinary methods requires an expenditure of money varying from $5 to $40 per acre. If goats can do this work just as thoroughly and at no other outlay than their own cost and that of a good fence and a shed, the question arises whether it is not more economical to employ them than to depend upon the laborious process of the grubbing hoe.

AS COMPARED WITH ANGORAS.

The thoughtful farmer, however, will survey all sources of income and outgo. He will consider the questions of disposal of the skins and the meat and of the animals themselves if he should produce a surplus or have no further need of them. These matters are discussed under other heads, but a little investigation will no doubt soon convince the farmer that the common goat is not so promising of profit as the Angora breed. The latter goat produces a fleece for which there is good demand at good prices, while the common goat contributes nothing of this kind. The Angora's flesh at all ages is nutritious and more palatable than that of the common breed; it is less inclined to jump or climb; there is an entire absence of the ill odor characteristic of bucks of the common breed, except during the rutting season. The value of the skins can not be compared, owing to an unsteady market for the Angora skins and the entire absence of prices for the very few domestic skins of the common goat that find their way to market. The manurial value is the same for both breeds. The Angora usually has but one kid a year, but there are occasional flocks where there are many pairs of twins. On the other hand, the rule among common goats is twins, and often triplets are dropped.

In addition to these facts there is profit in keeping Angoras for mohair production even after they may have served their purpose in clearing up land for cultivation. The keeping of common goats after this work is done is dependent upon the value of their skins and meat. At this time there is a ready sale for Angoras, while it can not be said that there is a market for the common breed, and one can hardly be developed if there is no profit in raising them for their skins.

AS MILK PRODUCERS.

The number of goats kept in the United States for milk production is known to be very small; it is also known that these are principally of the common breed, although there are occasional individuals among the Angoras that are excellent milkers.

A public-spirited gentleman of New Jersey has for many years been endeavoring to convert the common goat into a clean, healthful, hardy milch goat, and he has had pretty fair success. A good milch goat is one that will give at least two quarts of milk per day and have a period

of lactation of four to six months. Very few of the common goats of this country will do so well as that. If there are any that reach this standard they ought to be used as foundation stock for an American breed of milch goats.

The quality of the milk from the common goat is said to be as good as that from any other; and the healthfulness of goats' milk is everywhere acknowledged and recommended by those who have investigated the matter.

TARIFF RATES.

Goatskins are admitted free of duty, presumably owing to the great demand in this country and to the fact that they do not come into competition with a domestic industry.

The animals themselves are admitted free of duty, if imported for breeding purposes, upon condition that they are registered by a society recognized by the Government; but there are very few registered goats, other than Angoras, in the world; probably all are confined to England at this time, and so imported goats will be subject to the tariff rate of 20 per cent ad valorem. This fact will probably be of interest only to those who may contemplate importations of common goats from Mexico.

THE QUESTION OF PROFITS.

The purpose in this circular is to give the conditions as accurately as possible and in a simple and complete form so far as they relate to the question of raising common goats in the United States. It is assumed that no one would engage in this or any other enterprise without informing himself as to the conditions that he is likely to deal with in the venture; therefore the facts are given as they appear to the writer, and these ought to enable anyone to determine for himself whether or not it will be profitable to engage in the raising of goats. He will have to take into consideration a score of items of varying importance, such as cost of land, cost of labor, cost and extent of equipment, and cost of the goats, the supply of these animals from which to select his stock, and also the markets for the skins and meat.

The information of the Bureau of Animal Industry is that very few attempts have been made in this country to raise goats for their skins, and of these one only was upon a scale of commercial importance. In this case a company had an abundance of capital, good management, a ranch of cheap land but with an abundance of feed, and employed labor as cheaply as such labor could be had, yet the venture was declared a failure. It should be stated also that this company did its own tanning and manufactured the product into shoes, thus saving to

itself what would otherwise become middlemen's profits. The best net income that the company could realize for skin, carcass, and tallow was 80 cents per head.

The cost of carrying on the raising of these goats is the great drawback to the development of the industry here. A study of the table of imports shows that most of the goatskins come from countries where the cost of production is almost nothing. Similar conditions, except possibly as to the cheapness of land, do not exist in any part of our country.

MEAT ON THE FARM: BUTCHERING, KEEPING, AND CURING.[a]

By Andrew Boss,
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BUTCHERING THE ANIMALS.

SELECTION OF ANIMALS.

In the selection of animals for meat health should be given first consideration. No matter how fat an animal may be nor how good its form, if it is not in perfect health the best quality of meat can not be obtained. If suffering from fever or any serious derangement of the system, the flesh will not be wholesome food. Animals are often killed that are infected with actinomycosis (lumpy jaw), tuberculosis (consumption), cholera, swine plague, and other diseases of like nature. There is little direct evidence of harmful results from the use of such animals as food when in the early stages of disease, but since it is almost impossible to distinguish between the incipient and the fully developed forms of the disease, or to know when it becomes virulent, the safer course is to discourage the use of anything known to be in imperfect health. Flesh from animals that have recovered from the ravages of disease before slaughter is not likely to cure well and is very difficult to keep after curing. Bruises, broken limbs, or like accidents all have the same effect on the meat as ill health, and, unless the animal can be bled and dressed immediately after such accident, it is not best to use the meat for food. This would hold true especially if there has been a rise in temperature of 2° or more. A rise in temperature at or just previous to slaughtering is almost sure to result in stringy, gluey meat, and to create a tendency to sour in curing.

CONDITION.

First-class meat can not be obtained from animals that are poor in flesh. A reasonable amount of fat must be present to give juiciness and flavor to the flesh, and the fatter an animal is, within reasonable limits, the better will be the meat. The presence of large amounts of fat is not essential, however, to wholesome meat, and it is far more important that an animal be in good health than that it be extremely

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fat. "Never kill an animal that is losing flesh" is a maxim followed by butchers, and observation points to a logical reason for the saying. With an animal failing in flesh the muscle fibers are shrinking in volume and contain correspondingly less water. As a consequence the meat is tougher and dryer. When an animal is gaining in flesh the opposite condition obtains and a better quality of meat is the result. Also a better product will be obtained from an animal in only medium flesh, but gaining rapidly, than from a very fat animal that is at a standstill or losing in flesh.

BREEDING AND OTHER FACTORS.

Quality in meat is largely dependent on the health and condition of the animals slaughtered, and yet the best quality of meat is rarely, if ever, obtained from poorly bred stock. The desired "marbling," or admixture of fat and lean, is never of the best in scrub or native stock, nor do the "gaudy" fellows of the show ring, with rolls of fat on their ribs, furnish the ideal in quality of meat. There seems to be a connection between a smooth, even, and deeply fleshed animal and nicely marbled meat that is not easily explained. It is found that the two go together usually, unless the animals are carried along too far, in which case there may be a surplus of "spine," or outside fat.

Fine bones, soft, luxuriant hair, and mellow flesh are always desirable in an animal to be used for meat, as they are indications of small waste and good quality of meat.

AGE FOR KILLING.

Age affects the flavor and texture of the meat to quite an extent. While it is not possible to state the age at which an animal will be best for meat, it is a well-known fact that meat from old animals is more likely to be tough than that from young ones. The flesh of very young animals frequently lacks flavor and is watery. An old animal properly fattened and in good health would be preferable to a young one in poor condition.

Cattle are fit for beef at 18 to 20 months if properly fed, though meat from such animals lacks in flavor. The best meat will be obtained from animals from 30 to 40 months old, though they may be used at any age if in good condition. A calf should not be used for veal under 6 weeks of age, and is at its best when about 10 weeks old and raised on the cow. There is a law in most States against selling veal under 6 weeks of age. Hogs may be used at any age after 6 weeks, but the most profitable age at which to slaughter is 8 to 12 months. Sheep may be likewise used when 2 to 3 months of age and at any time thereafter. They will be at their best previous to reaching 2 years of age, usually at 8 to 12 months.

PREPARATION OF ANIMALS FOR SLAUGHTER.

It is important that an animal intended for slaughter should be kept off feed from twenty-four to thirty-six hours. If kept on full feed the system is gorged and the blood, loaded with assimilated nutrients, is driven to the extremities of the capillaries. In such a condition it is impossible thoroughly to drain out the veins when the animal is bled, and a reddish colored, unattractive carcass will be the result. Food in the stomach decomposes very rapidly after slaughter, and where the dressing is slow the gases generated often flavor the meat. Water should be given freely up to the time of slaughter, as it keeps the temperature normal and helps to wash the effete matter out of the system, resulting in a nicely colored carcass.

The care of animals previous to slaughter has considerable effect on the keeping qualities of the meat. It is highly important that they be not excited in any way sufficiently to raise the temperature of the body. Excitement prevents proper drainage of blood vessels, and if extreme will cause souring of the meat very soon after dressing. In no instance should an animal be killed immediately after a long drive or after a rapid run about the pasture. If heated by such cause it is far better to allow it to rest overnight before killing than to risk the meat spoiling. The flesh of an animal that has been overheated is usually of a pale color, and very often develops a sour or putrid odor within three or four days after being dressed. It is also essential that the animal be carefully handled, so as not to bruise the body. Bruises cause blood to settle in that portion of the body affected, presenting an uninviting appearance, and often cause the loss of a considerable portion of the carcass. A thirty-six-hour fast, plenty of water, careful handling, and rest before slaughter are all important in securing meat in the best condition for use, either fresh or for curing purposes.

KILLING AND DRESSING CATTLE.

Where much meat is prepared for use on the farm it will be best to provide such tools as are necessary for the rapid prosecution of the work. A 7-inch curved skinning knife at 35 cents, an 8-inch straight sticking knife at 35 cents, a 14-inch steel at $1, a 28-inch meat saw at $2, a candlestick scraper at 25 cents, and an ax are all of the tools really essential to rapid dressing (fig. 23). Some means of raising the carcasses of beef from the ground or floor and a place to hang the lighter animals should also be provided. What these arrangements shall be depends largely on the amount of work to be done and the circumstances. A block and tackle with 6-inch pulleys (fig. 24) will answer the purpose very well where they may be had and a suitable place is at hand for suspending them. In its absence various appliances may be used, some of which are suggested by accompanying illustrations.

The first step in killing and dressing a beef is to secure the animal so that it can not get away under any emergency. For this purpose a rope three-fourths of an inch in diameter should be used. Put a slip noose in one end with a knot just far enough from the noose to prevent choking when drawn tight. It should at the same time allow the noose to draw tight enough so that there will be no danger of escape if the rope becomes slack. If the beast has horns, pass the noose over the head back of the ear and horn on the rightside but in front of the horn on the left side of the head. This leaves the face bare and does not draw tightly on the throat. Where a dehorned or polled beast is to be secured the noose must be adjusted around the neck. Attach an ordinary hayfork pulley to a post, close to the ground, or to the barn floor or sill. Pass the rope through it and draw the animal's head down as close as possible. Stun completely by a heavy blow in the center of the forehead at the point where lines drawn from the eye on either side to the base of the horn on the opposite side would intersect (fig. 24).

Shooting has the same effect as stunning, and where deemed best may be resorted to. Some danger attends the use of a rifle about farm buildings, however, and the use of an ax is advisable where the animal can be caught.

BLEEDING.

Bleed by sticking the animal just in front of the sternum, or breastbone. To do this properly requires practice and close observation (fig. 25). Stand in front of the neck of the animal with the back toward the body. Place one foot against the jaw and with the other hold back the front legs. Reaching down between the feet, lay open the skin from breastbone toward the chin for a distance of 10 or 12 inches, using the ordinary skinning knife. Insert the knife with the back against the breastbone and the tip pointed directly toward the spinal column at the top of the shoulders, cutting just under the windpipe, and about 5 to 6 inches in depth. The vein and artery cross just at this point, and if they are severed the blood will flow out very rapidly. When the vein has been cut below the windpipe, run the knife in on top of it and sever the blood vessels on that side also. If stuck too deep the pleura will be punctured and blood will flow into the chest cavity, causing a bloody carcass. This should be avoided.

While an animal will bleed out if only one side is cut, it will bleed more quickly and the blood will be more nearly siphoned out if both sides are opened. A little practice is needed to become expert in "sticking" a beef, but, once learned, the art is never forgotten. Not so much skill is required simply to cut the animal's throat back of the jaws, but it is at the expense of quick bleeding.

SKINNING AND GUTTING.

Begin skinning as the carcass lies on its side by splitting the skin through the face from poll to nose (fig. 26). Skin the face back over the eyes on both sides and down over the cheeks. Cut around the base of the horns, leaving the ears on the hide. Split the skin from the chin down the throat to meet the incision made in bleeding. Start the skin in slightly on the sides of the neck and down to the jaws. Remove the head by cutting from just back of the jaws toward the depression back of the poll. The atlas joint will be found at this point, and may easily be unjointed with the knife. The carcass should then be rolled on its back and held by a small stick 3 feet long, with a sharp spike in each end, one end being inserted in the brisket and the other in the floor. Split the skin over the back of the fore legs from between the dew claws to a point 3 or 4 inches above the knee. Skin around the knee and shin, unjointing the knee at the lowest articulation (fig. 27), and skin clear down to the hoof. The brisket and forearms should not be skinned until the carcass is hung up. Cut across the cord over the hind shin to relax the foot. Split the skin from the dew claws to the hock and up over the rear part of the thigh to a point 4 to 6 inches back of the cod or udder. Skin the hock and shin, removing the leg at the lowest joint of the hock (fig. 28). In splitting the skin over the thigh the knife should be turned down flat with the edge pointed outward to avoid gashing the flesh. While the hind leg is stretched ahead it is well to skin down over the rear of the lower thigh, but no attempt should be made to skin the outside of the thigh until the hind quarters are raised. After the legs are all skinned split the skin over the mid line from breast to rectum.

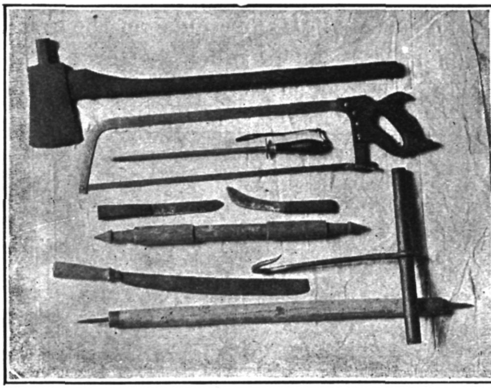

FIG. 23.—Tools for farm slaughtering: Ax, saw, steel, sticking knife, skinning knife, hog gambrel, hog hook, corn knife, pritch.

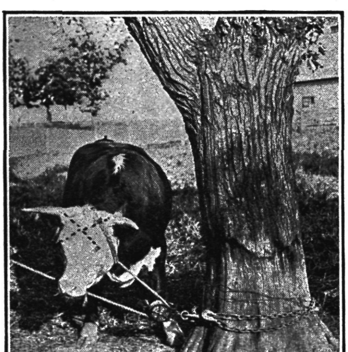

FIG. 24.—Beef: Illustrating method of securing to stun. Intersection of dotted lines shows place to strike.

Begin at the flanks and skin along the mid line until the side is nicely

started. Then, with a sharp knife held nearly flat against the surface and the hide stretched tightly, remove the skin down over the sides with steady downward strokes of the knife (fig. 29). It is important that the skin be stretched tight, with no wrinkles in it. Care should be taken to leave the covering of muscle over the abdomen on the carcass. Its presence on the hide is not entirely objectionable, but a carcass looks much better and keeps better with it on. In "siding" a beef it is customary to go down nearly to the backbone, leaving the skin attached at the thighs and at the shoulders; skin over the buttock and as far down on the rump as possible. Care should be taken at all times to avoid cutting into the flesh or tearing the membrane covering it. If the meat is to be kept fresh for any length of time mold will form in such places and will be hard to clean off. A coarse cloth and a pail of hot water should be at hand while skinning, and all blood spots should be wiped from the surface. The cloth should be wrung nearly dry for this purpose.

FIG. 25.—Beef: Place to stick and manner of sticking.

Open the carcass at the belly with a knife and pull the small intestines out to one side. Open the brisket and pelvis with a saw or sharp ax. After raising the windpipe and gullet and cutting loose the pleura and diaphragm along the lower part of the cavity, the carcass is ready to raise (figs. 30 and 31).

When raised to a convenient height remove the hide over the thighs, rump, and hips. While in this position loosen the rectum and small intestines and allow them to drop down over the paunch. The "bed fat" lining the pelvis and the kidney fat should not be disturbed or mutilated.

FIG. 26.—Beef: Skinning the face, illustrating manner of starting to skin a beef.

The intestines are attached to the liver, from which they may be separated with a knife. The paunch is attached to the back at the left side and may be pressed down upon with sufficient force to tear it loose (fig. 32). Let it roll onto the ground, and cut off or draw out the gullet. Raise the carcass a little higher and take out the liver, first removing the gall bladder. Remove the diaphragm, lungs, and heart, and finish skinning over the shoulders, arms, and neck (fig. 33). Sponge all blood and dirt off with the cloth. Split the

carcass into halves with a saw, if one can be had; if not, use a cleaver or a sharp ax. Wash out the inside of the chest cavity and wipe it

FIG. 27.—Beef: Showing manner of unjointing fore leg and skinning shank.

dry. Trim off all bloody veins and scraggy pieces of the neck, and leave the beef to cool before cutting into quarters (fig. 34).

DRESSING VEAL.

Veal for home use should be dressed in a manner similar to beef, except that more of the work should be done with the body hung up. The calf should be skinned while warm and the entrails removed, the pelvis and sternum being split as for beef. The calf should be over six weeks old, and will make better veal if it has been allowed to run with the mother. The fat in the carcass should be abundant, white and brittle.

FIG. 28.—Beef: Unjointing the hind leg.

TREATMENT OF HIDES.

The skins of cattle represent considerable value if properly saved. To save them is an easy matter during the cold season in the North, as they may be rolled up and kept frozen until disposed of. In the South and in warm seasons, however, they should be spread out flat, hair side down, the legs, flanks, etc., stretched, and all parts rubbed thoroughly with common salt. Particular pains should be taken to reach all surfaces of the skin. If more than one skin is to be

salted, they should be spread one on top of the other, and salted as spread, with the hair side down. Where only one hide is to be handled, the legs and head should be folded in and the hide rolled up as soon as salted. Enough salt should be used to cure the hide thoroughly if it is to be kept for any length of time. Ten to 12 pounds of salt will be sufficient for an ordinary hide.

FIG. 29.—Beef: "Siding down;" knife held flat against the tightly stretched skin.

KILLING AND DRESSING SHEEP.

Much of the "sheepy" flavor of mutton comes from the generation of gases in the stomach after the sheep is killed. For this reason sheep should be dressed as rapidly as possible. A platform 6 or 8 inches high is a convenient thing to work on and aids in keeping the blood away from the body, insuring a cleaner carcass. A clean dry place is necessary for neat work. Water or blood on the wool makes it very difficult to dress the animal nicely.

If the sheep is an old one it may be stunned before bleeding. If a young one the same purpose is served by dislocating the neck after cutting the throat. This is accomplished by putting one hand on the poll or top of the head and the other hand under the chin, giving a sharp twist upward. Lay the sheep on its side on the platform, with its head hanging over the end. Grasp the chin in the left hand and stick a knife through the neck, just back of the jaw (fig. 35). The cutting edge of the knife should be turned toward the spinal column and the flesh cut to the bone. In this way it is possible to avoid cutting the windpipe.

FIG. 30.—Beef, ready to raise: Breast, forearms, and neck left covered to protect the meat until the carcass is raised.

SKINNING.

Split the skin over the back of the front legs from the dew claws to a little above the knees (fig. 36). Open the skin over the windpipe

from brisket to chin, starting it slightly on the sides of the neck. Split the skin over the back of the hind legs to the middle line and skin the buttock. The skin should also be raised over the cod and

FIG. 31.—Beef: Raising the carcass. Block and tackle suspended from a tree. Two-horse evener used as a gambrel.

flanks. Skin around the hocks and down to the hoofs, cutting off the hind feet at the toe joints. Run the knife between the cords and bone on the back of the shins, and tie the legs together just above the pastern joints. No attempt should be made to skin the legs above the hock until after the carcass is hung up. Hang the sheep up by the hind legs and split the skin over the middle line. Start at the brisket to "fist off" the skin. This is done by grasping the edge of the pelt firmly in one hand, pulling it up tight and working the other with fist closed between the pelt and the body (fig. 37). The "fisting off" should be downward over the fore quarters and upward and backward over the hind quarters and legs. It is unwise to pull down on the skin over the hind legs, as the membrane covering the flesh is sure to be ruptured and an unsightly appearance given to the carcass. The wool should always be held away from the flesh for the sake of cleanli-

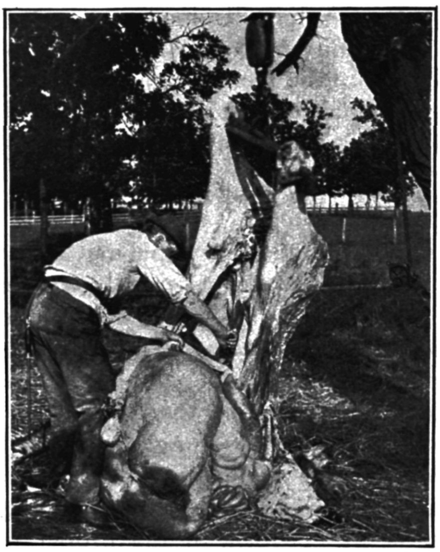

FIG. 32.—Beef: Removing paunch and intestines.

ness. The skin on the legs should be pulled away from the body rather than toward it, in order to preserve the covering of the meat. When the pelt has been loosened over the sides and back it should be stripped down over the neck and cut off close to the ears. The head may then be removed without being skinned by cutting through the atlas joint.

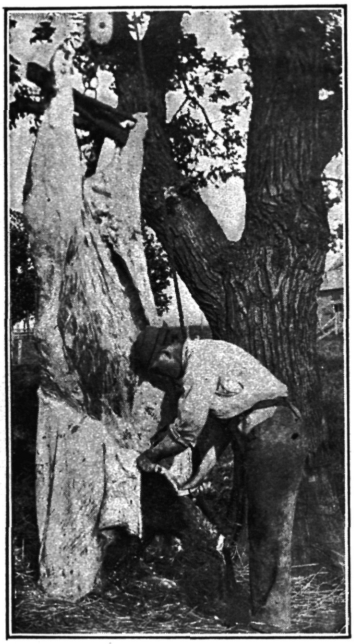

FIG. 33.—Beef: Skinning shoulders and forearms.

GUTTING.

Begin removing the entrails (fig. 38) by cutting around the rectum and allowing it to drop down inside. Do not split the pelvis. Open down the belly line from the cod to the breastbone and take out the paunch and intestines, leaving the liver attached to the diaphragm. If the mutton is for home use, split the breastbone and remove the heart, lungs, and diaphragm together. For marketing it is best not to split the breast. Reach up into the pelvis and pull out the bladder. Wipe all blood and dirt from the carcass with a coarse cloth wrung nearly dry from hot water. Double up the front legs and slip the little cord, found by cutting into the fleshy part of the forearm, over the ankle joints.

KILLING AND DRESSING HOGS.

Quite essential for rapid and neat work at hog-killing time is proper equipment. A good sticking knife, hog hook, scrapers, and a convenient place for working are among the important items of consideration. A barrel is the receptacle commonly used for scalding, and there is no need of anything better. If it is set at the proper slant, with the open end against a table or platform of the proper height and the bottom securely fastened, there is little danger of accidents and the work can be quite easily performed. A strong table built for the purpose would be a very desirable thing on which to

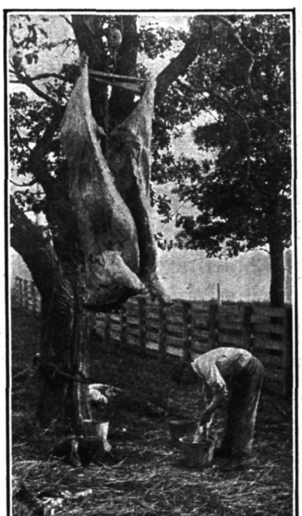

FIG. 34.—Beef raised out of the way of animals to cool.

work, though it is not absolutely necessary. A box often serves very well.

The same caution should be observed about exciting or heating hogs before slaughtering, as is noted in discussing the dressing of beef. The more quietly they can be handled the better. In catching and throwing them bruising must be avoided.

It is not customary to stun hogs before sticking them, although in some localities this is commonly done. At slaughterhouses they are usually hung up by one hind leg for sticking, and where appliances are at hand and labor is scarce that is advisable. The more common way, however, is to lay the animal on its back, where it is held until stuck. Two men can handle a large hog if they work intelligently. By reaching under the animal, one at the fore legs and one at the hind legs, they can turn a heavy hog on its back easily. Then one man, standing astride the body with his feet close against its sides and holding its front legs, can easily control it while the other does the sticking (fig. 39). The knife, narrow, straight-bladed, 8 inches long, is inserted into the hog's throat just in front of the breastbone. The point is directed toward the root of the tail and held exactly in line with the backbone. This is necessary to avoid running it between the ribs and the shoulder, causing the blood to settle there, with consequent waste in trimming or a poorly keeping shoulder. When the knife has been run into the neck 6 to 8 inches, the depth depending on the size of the hog, it should be given a quick turn to one side and withdrawn. The arteries that are to be cut run close together just inside of the breastbone and will both be severed when the knife is turned, provided it is sharp on both sides of the point.

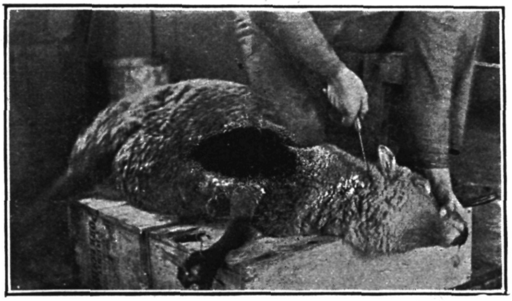

FIG. 35.—Manner of sticking a sheep.

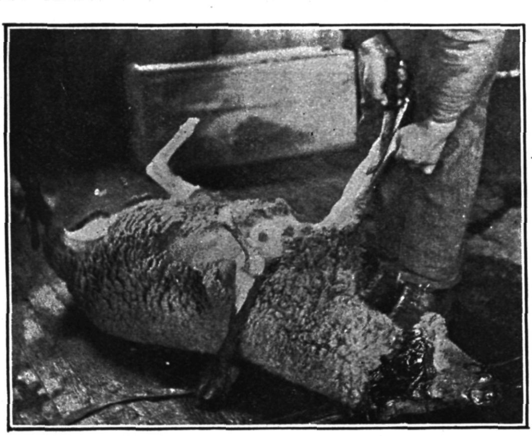

FIG. 36.—"Legging out" a sheep.

SCALDING AND SCRAPING.

The water for scalding should be heated to a temperature of 200° to 212° F. Where it must be heated in the house, as is often the case, it should be boiling when removed from the stove. If put into a cold barrel it will then be about the right temperature when the hog is ready to be scalded. It may not be out of place to state that the water should be nearly boiling before the hog is killed, but should not be removed from the fire until the hog is nearly dead. At the time the hog is scalded (fig. 40) the water should be at a temperature of 185° to 195°. Water at 165° to 175° will scald a hog, but more time will be required, and the results are hardly as satisfactory. If the water is too hot the hair is likely to set, causing even more trouble than if too cold. It is not expected that a thermometer will always be used, but if the water is boiling when taken from the stove and put into a cold barrel the temperature will be about right. If the barrel is hot, as it would be ordinarily for the second hog scalded, add a half pail of cold water. By testing the water with the finger each time, one can soon become expert in gauging the temperature. A small shovelful of hardwood ashes added to the water aids materially in removing the scurf from the body, though it has no effect in loosening the hair. A lump of lime, a handful of soft soap, a little pine tar, or a tablespoonful of concentrated lye has the same effect.

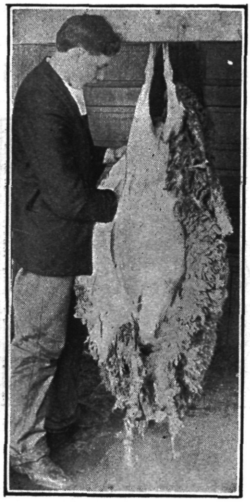

FIG. 37.—Fisting off the pelt.

The hog should not be scalded before life is extinct, or the blood in the small blood vessels near the surface of the skin will be cooked, giving a reddish tinge to the carcass. While being scalded the hog should be kept moving constantly to avoid cooking the skin. Occasionally it should be drawn out of the water to air—when the hair may be "tried." As soon as hair and scurf slip easily from the surface, scalding is complete. If it is suspected that the water is too hot, scald the hind end first; if

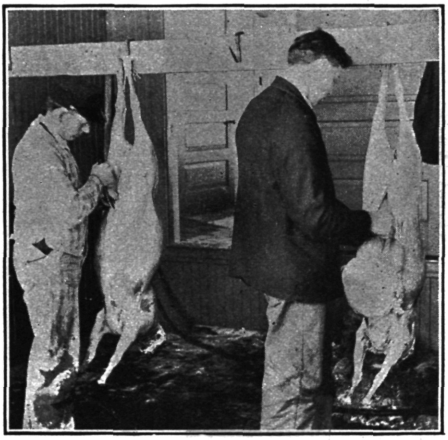

FIG. 38.—Removing the intestines of sheep.

too cold, the front end, in order to always get a good scald on the head, which is difficult to clean.

When the hair starts readily, remove the animal from the water and begin scraping. The head and feet should be cleaned first, as they cool quickly and do not clean so easily when cold. The head can best be cleaned with a small round tool called a "candlestick" scraper. The hands and a knife will answer where such a scraper is not to be had. The feet and legs are easily cleaned by grasping them firmly with the hands and twisting around and back. Clean the body by pulling out the long bristles by hand and removing the scurf and fine hair with a scraper, a long corn knife, or other tool. Rinse over the entire carcass with hot water, then shave it with a sharp knife. Clean the ears and nose thoroughly and the feet clear to the hoofs. Raise the gambrel cords, insert the stick, and hang up the hog (fig. 41). Wash down with hot water, again shave over any unfinished patches, and rinse with cold water.

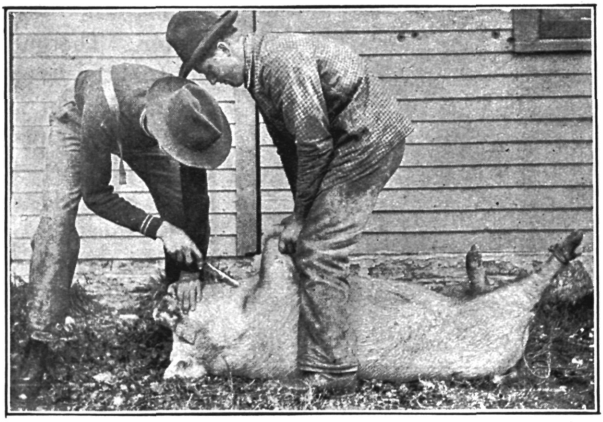

FIG. 39.—Manner of holding and sticking a hog.

Occasionally a hog is killed that is too large to scald in a barrel. If it is covered thickly with blankets or with sacks containing a little bran and hot water poured over it the hair will be loosened readily. In some localities hogs are skinned, but scalding is far more satisfactory.

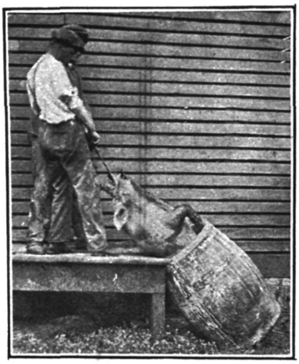

FIG. 40.—Scalding a hog. Note arrangement of table and barrel.

GUTTING.

In removing the entrails (fig. 42) first split the hog between the hind legs, separating the bones with the knife. This can easily be done if the cut is made directly through the joint. Run the knife down over the belly line, shielding the point with the fingers of the left hand and guiding it with the right. There is little danger of cutting the intestines in this way. Split the breastbone with the knife or an ax and cut down through

the sticking place to the chin. Cut around the rectum and pull it down until the kidneys are reached, using the knife wherever necessary to sever the cords attaching it to the "bed." Do not disturb the kidneys or the fat covering them, except in warm weather, when the "leaf" may be removed to allow quicker and more thorough cooling. Remove the intestines and paunch together. The gall bladder lies in plain sight on the liver as it lies attached to the diaphragm and hepatic vein. It should be stripped off after starting the upper, or "duct," end with the knife. Avoid spilling the contents on the meat. Insert the fingers under the liver and strip it out. Cut across the artery running down the backbone and cut around the diaphragm, removing them with the "pluck"—that is, heart, lungs, gullet, and tongue. Open the jaw and insert a small block to allow free drainage. Wash out all blood with cold water and sponge out with a coarse cloth. In hot weather the backbone should be split to facilitate cooling. The fat should be removed from the intestines before they get cold. Since it is strong in flavor it should not be mixed with the leaf lard in rendering.

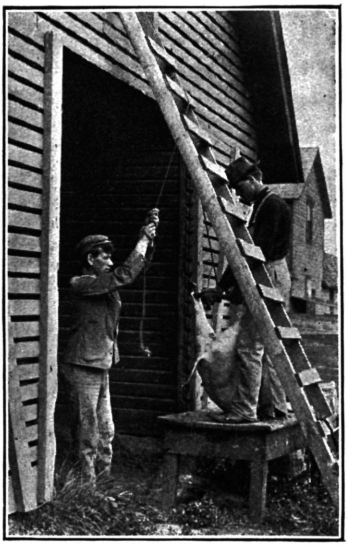

FIG. 41.—A convenient way of hanging up a hog.

KILLING AND DRESSING POULTRY.

Poultry for use in the farm home is dressed in small quantities and kept only a few days at the most; hence circumstances will dictate largely the methods to be followed.

Where only one or two chickens are to be dressed there is no quicker nor surer way of bleeding than the old-fashioned one of chopping off the head. If to be used in a day or two, they should be scalded at once and picked. If they are plunged into a pail of very cold water as soon as picked, the heat will be taken out of the skin and the bird will keep without the skin drying so much. The crop and intestines should be removed as soon as the skin is cooled, though if

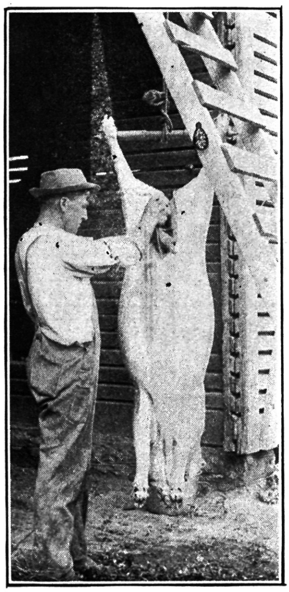

FIG. 42.—Opening the abdomen to remove the intestines.

they are empty no harm will come from leaving them undrawn until the fowl is wanted for use.

Turkeys, geese, and ducks may be treated in the same way, though they are usually bled and dry picked. In dry-picking turkeys, as soon as the feathers droop, showing that collapse has begun, picking should begin with the bird suspended from a hook. It is important that it be done rapidly, so as to complete the work before the feathers set. Grasping only a few feathers between the finger and thumb, pull upward and backward. Leave the bird hanging until cool in order that the blood may settle to the head.

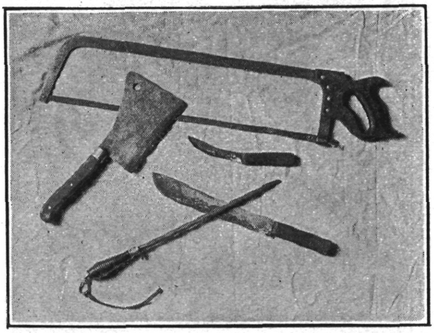

FIG. 43.—Tools for cutting meat: Saw, cleaver, steak knife, skinning knife, steel.

With ducks and geese, owing to the thickness of the feathers, dry picking is a slower process than with other fowls. After bleeding, place a board across an open barrel that is clean. Wrap a cloth around the head of the fowl to catch the blood. Lay the goose or duck on the board, and with thumb and finger strip the feathers into the barrel. When the feathers have been removed the down may be singed off with a gasoline or alcohol flame. A hot flame should not be used, as it will give an oily appearance to the skin.

Where it is not important to save the feathers, quicker work may be done by scalding the fowls and wrapping them in a sack or blanket to steam for a few minutes; since there is a little danger of their being steamed too much they should be closely watched. The feathers may then be removed as above and the birds cooled and singed.

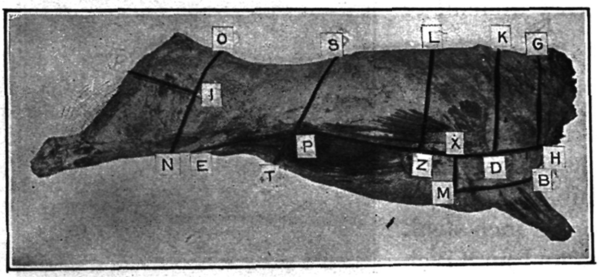

FIG. 44.—Carcass of beef showing wholesale cuts.

KEEPING OF MEATS.

COOLING THE CARCASS.

While it is almost impossible to get the best conditions for handling meat on the farm, a knowledge of the best principles may aid in getting a better quality of meat. It is very important that the carcasses be cooled soon after slaughtering, and yet that they be not allowed to freeze. While the temperature can not well be controlled on the farm, it is possible to slaughter when the weather is favorable to the proper cooling of the carcass. If during the winter

season, choose a day when there is a prospect for cooling the carcass before the surface freezes. The most desirable temperature for cooling meat is 34° to 40°, and an approach to these temperatures will give good results.

In summer time it is best to dress the animal in the evening, leaving the carcass in the open air overnight and carrying it to a cool, dark cellar before the flies are out in the morning. Very often a cool room in the barn can be used for the purpose if made dark. There should be no fresh paint, tar, kerosene, or like substance around, however, as freshly killed meat absorbs such flavors readily. Cooling is often hastened by splitting the carcasses into halves or even into small pieces. It is best, however, not to divide the carcass until the meat is firmly set, unless absolutely necessary to prevent it from souring. For the best results in cooling meat, the air should be dry, as well as of a low temperature; and free circulation aids greatly in carrying away foul odors and mold spores.

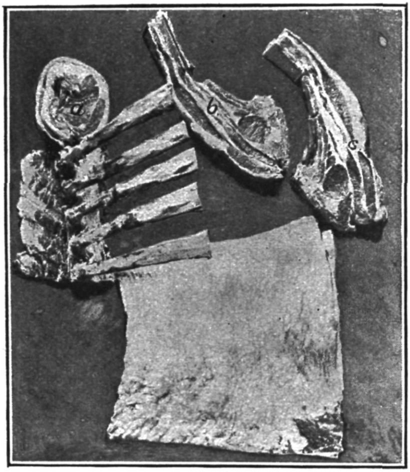

FIG. 45.—Prime ribs of beef: *a*, Rolled roast; *b*, folded roast; *c*, standing roast.

It is also important that flies and insects be kept away from the meat. If flyblown, maggots will soon appear and it will be very difficult to save the meat.

CUTTING UP MEAT.

To do neat work in cutting up meat one should have a short, curved knife (a skinning knife is as good as any), a 12 or 14 inch steak knife, a 26-inch saw, and an 8-inch cleaver. An ax may take the place of the cleaver, but is not nearly so useful (fig. 43). If a cross section of a large log can be had it will answer for a block. A table, however, can be used in most cases.

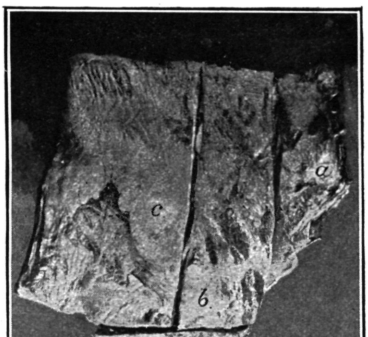

FIG. 46.—Square chuck of beef showing divisions: *a*, Neck; *b*, shoulder; *c*, chuck ribs; *d*, cross ribs.

In cutting any kind of meat one should always cut across the grain of the meat. Following this principle will result in uniform pieces

and the joints will be more easily carved after cooking. Cut to the bone with the knife, and use a saw rather than an ax for cutting the bone.

THE CUTS OF BEEF.

Beef should not be cut until the muscles have set firmly. When they are in the proper condition divide the halves into hind and fore quarters, from S to T, between the twelfth and thirteenth ribs (fig. 44). This leaves one rib in the hind quarter. Lay the hind quarter on the block or table with the inside up. Remove the kidney and suet. Cut off the flank as indicated by the line N to P in the illustration. Turn the quarter over and cut off the loin, beginning at the middle of the sacrum near O, and cutting to a point $1\frac{1}{2}$ or 2 inches above the stifle joint at N. If cut as directed but little sawing will be necessary, as the division will be made in front of the ball-and-socket joint of the hip. Turn the remainder of the quarter over and separate the rump from the round just below the pelvic arch and parallel to the backbone, as indicated by line R to I.

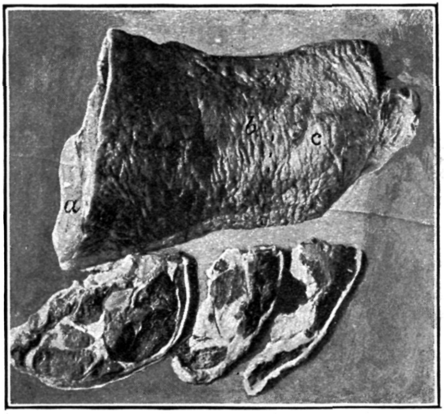

FIG. 47.—Loin of beef: *a*, Sirloin steak; *b*, porterhouse; *c*, sirloin strip.

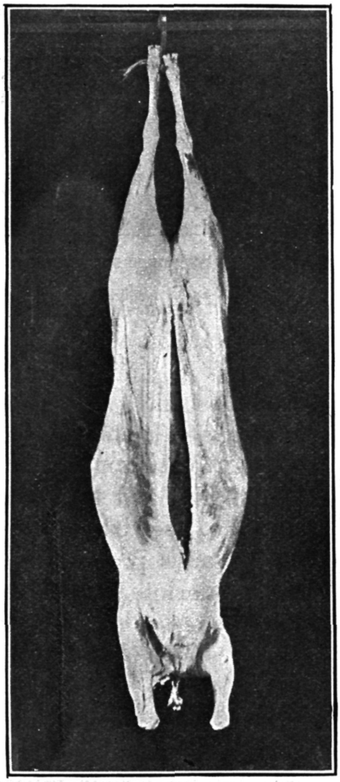
FIG. 48.—Finished carcass of mutton.

Lay the fore quarter on the block with the outside up. Beginning at P (fig. 44), 12 to 15 inches down the rib from the spinal column—the distance depending on the thickness of the meat—cut across the ribs to the armpit above M. Cut between the third and fourth ribs to M, and then across the shank to B. Then cut off the "cross ribs" just below the shoulder joint, H to D. The prime "ribs" (fig. 45) are then taken off between the fifth and sixth ribs, counting from the front. This cut contains seven ribs, and is usually taken off in one

piece, though it may be cut into as many as are desired. Cut off the remaining five ribs, called "chuck ribs" (fig. 46*c*), making the division between the first rib and the shoulder bone. Divide the neck and shoulder, G to H. These cuts are all too large for family use, and may be again divided into joints of suitable size for the table as wanted.

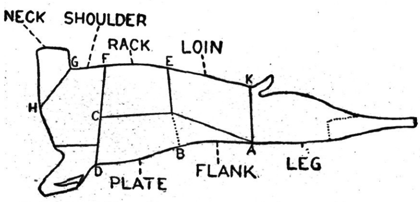

FIG. 49.—Method of cutting up a carcass of mutton.

USES OF THE CUTS OF BEEF.

The uses of the cuts of beef are, of course, varied to suit customs and families. There is no portion of the carcass that may not be cooked by boiling or by roasting. The texture of the muscles and the admixture of fat and lean each have an effect on the palatability and tenderness of meat. The mode of cooking will be in accordance with the joint at hand.

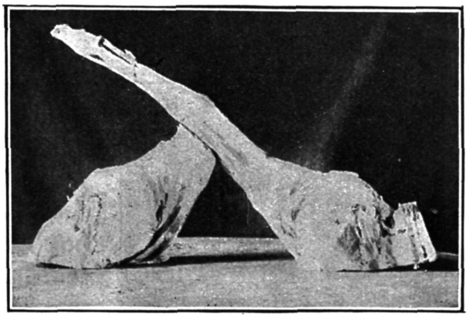

FIG. 50.—Leg of mutton: Untrimmed and trimmed.

The flank is usually boiled or braized, but is also suitable for corning. Flank steak is sometimes cut from the lean muscle on the inside of the flank. The loin is commonly cut into steaks, though fancy trade often demands its use for roasting. In cutting steak from the loin one should begin at the "butt," or rear end, and cut parallel to the line N O (fig. 44). The first slices cut are the sirloin steaks (fig. 47*a*). They continue until the "hook point" is passed, when the slices are termed porterhouse steaks (fig. 47*b*). These contain both the sirloin and tenderloin muscles, the sirloin above the spinous processes and the tenderloin muscle below. Unless both muscles are present it is not porterhouse steak. The porterhouse steaks are often erroneously called tenderloin steaks. The tenderloin steak consists of only the tenderloin muscle stripped from beneath the loin. Since it destroys the value of the porterhouse steaks to strip out the tenderloin muscle, the tenderloin

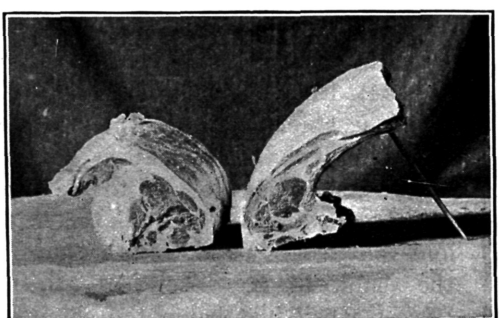

FIG. 51.—Mutton: Loin cut and rib cut for chops.

steaks are usually taken from thin cattle of the "canner" class. Porterhouse steaks are cut from the hip bone fôrward until the end of the tenderloin muscle is reached. The end of the loin containing the rib is used for roasting, though it may be cut into steak if desired. The rump, cut into suitable-sized pieces, makes pot roasts or boiling pieces of good quality. The round of beef is usually cut into steaks. If cut into pieces 4 to 6 inches thick it makes delicious roasts. Steaks should not be cut below the stifle joint. The remainder of the round may be used for pot roasts.

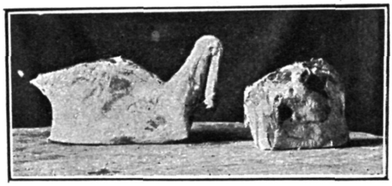

FIG. 52.—Shoulder of mutton: Untrimmed and trimmed.

The seven best ribs are used as oven roasts, and may be divided into one, two, or three rib pieces, as desired. It is from this joint that the rolled roasts are obtained; hence its high value. The chuck-rib cut may likewise be subdivided into one or two rib pieces for oven roasts, or, in the case of old or tough beef, for pot roasts. In making the "best-rib" and "chuck-rib" cuts the divisions should always be made parallel with the ribs. The shoulder is used for boiling, corning, or mincemeat; the plate cut in strips across the ribs is used for stews and corning, and the shanks and neck for soup stock, mincemeat, or sausage.

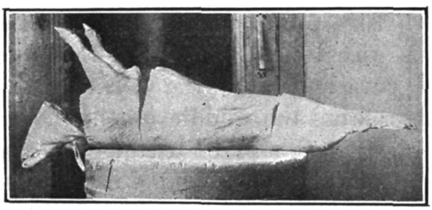

FIG. 53.—Carcass of pork: Head, shoulders, middle, hams.

CUTTING MUTTON.

First split the carcass (fig. 48) into halves, then cut off the flank and breast, following the line A B C D (fig. 49). Cut off the leg at the top of the round, A to K, just touching the hip joint. Remove the shank below the fleshy part of the leg. Cut off the shoulder between the third and fourth ribs and the neck at the shoulder vein. Remove

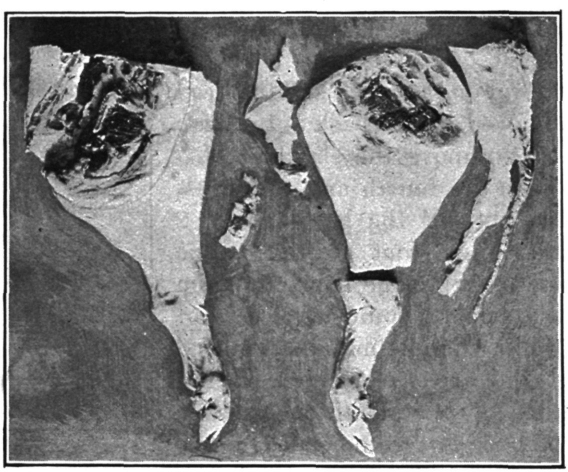

FIG. 54.—Hams: Trimmed and untrimmed.

the front shank at the elbow joint. Where a "saddle of mutton" is wanted, one must deviate from this method of cutting and cut the saddle in one piece before the carcass is split into halves.

The leg of mutton (fig. 50) is sometimes cut into steak, but is usually roasted whole or boiled. The loin may be used for chops (fig. 51), the slices being cut parallel to the ribs, or it may be roasted, if desired. The chops should be cut "one rib" thick. If used as an oven roast the joints in the backbone should be cracked with a cleaver to admit of easy carving at the table. The rack is used in the same way as the loin. The joints in the back of the shoulder (fig. 52) should be cracked and the ribs broken across the middle on the inside, when it may be used as an oven roast from a young mutton, or as a boiling piece if from an old one. The breast and flank, when trimmed, are used for stews; the neck and shank, for soup stock.

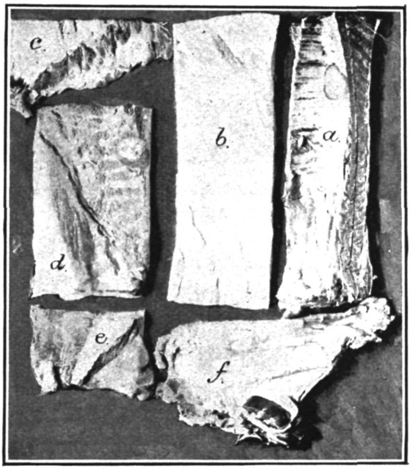

FIG. 55.—Side cuts of pork: *a*, Loin; *b*, fatback; *c*, spareribs; *d*, bacon strip; *e*, trimmings; *f*, leaf.

CUTTING PORK.

Pork is unlike beef and mutton in that it should be cut just as soon as it is cooled through. If the carcass (fig. 53) has not been split to aid quick cooling, it should be laid on the block and the head removed an inch back of the ears. Next remove the shoulders between the fourth and fifth ribs, and cut off the hams about 2 inches in front of the pelvic bones. Split the hams and trim to a smooth, rounded piece (fig. 54*b*). The feet may be removed at the hock joints, but sawing them off a couple of inches above the hock is recommended, as the hams will then pack much closer in the barrel. Split the middle piece with a saw or ax, and remove the leaf if this was not done when the hog was dressed. This may be easily accomplished by starting the leaf at the front end and peeling it backward with the fingers. The kidney comes out with the fat.

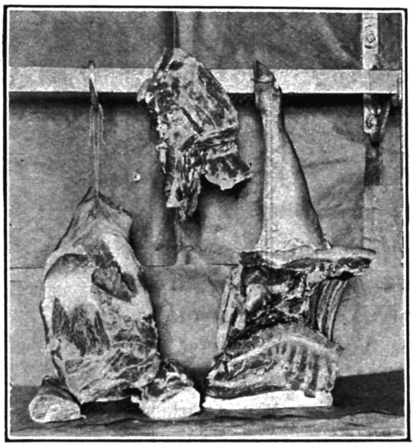

FIG. 56.—Pork shoulders: Untrimmed and trimmed, with trimmings.

Take out the loin (fig. 55*a*) and sparerib, leaving the lean meat found along the back on the loin, which may be used fresh as chops or for roasting.

When a line corresponding to the line O P is reached the separation should be made as close to the rib as possible, thus improving the quality of bacon. Cut the side lengthwise into three evenly sized strips, or if to be cured and smoked, into two pieces, the upper one-third (called the back strip) for salt pork or lard, and the lower two-thirds (called the bacon strip) for bacon. The edges should always be trimmed up square, and all scraggy parts used for sausage or lard. Take the ribs and neck bones out of the shoulder (fig. 56) and trim it down to the top of the shoulder blade. Trim off all bloody spots and neck meat. Remove the foot above the kneejoint. Split the head through the center and then into quarters. On heavy hogs the jowls are often removed for salting before the head is split. The hams, shoulders, and bacon strip may be cured and smoked, the loin cut into chops or roasts, as in mutton, and used fresh. All lean trimmings are made into sausage and fat trimmings into lard. The feet, snout, and ears are pickled and the head boiled for headcheese.

If it is not intended to use the side pork as bacon, it is advisable to cut it into smaller pieces, as it packs closer in the barrel.

CUTTING VEAL.

Veal is cut in a manner similar to mutton, the main difference being in the rump cut. The method in brief is as follows: Remove the flank and breast as in mutton; cut off the leg at the hip joint; cut the rump from the leg below the pelvic bones; cut the loin and ribs into chops or roasts as desired. The shoulder may also be used as a roast. It is more easily carved if the shoulder bones are removed before cooking.

The leg of veal is used as cutlets, veal steak, or as a fillet of veal for roasting.

KEEPING FRESH MEAT.

COLD STORAGE.

Meat used while fresh is more nutritious and palatable than salted or cured meats. It is therefore desirable to use as much of it uncured as possible. It is very difficult to keep meat fresh during the summer months without the use of ice, and even then but little can be handled at one time on the ordinary farm. Where a room or family refrigerator can be kept at a temperature of 40° or less, with good ventilation and circulation of air, fresh meat can be kept for a week or ten days. It is very important that the circulation be free and the air dry. Moisture in a refrigerator tends to develop wet mold or slime and a little decay soon contaminates the whole piece. Less difficulty will be experienced in keeping fresh meat if it is kept in a

room where the temperature is high and the air dry than where the temperature is low and the air damp.

Where an ice house is filled each year a small portion of it may be partitioned off as a cold-storage room. With the ice properly packed on three sides of it, an with good drainage, this makes a very satisfactory place for keeping meat, and it may also be used for storing butter and other perishable products.

In the North meat is kept during the cold season by freezing. A carcass is cut up into quarters, or even smaller pieces, and hung in an outbuilding, where it will remain frozen solid. When aportion is wanted it may be cut off with a saw. If the meat is taken into a cold room and slowly thawed out the flavor is only slightly injured. No more should be taken in at one time than is wanted for immediate use. Repeated freezing and thawing are injurious to the flavor and quality of the meat; hence the importance of keeping it where the temperature will remain sufficiently low to prevent thawing.

Insects should not be allowed to get at the meat. For this reason a dark, cool cellar is the best place for keeping fresh meat on the farm. The cellar should be clean and free from odors or the meat will become tainted.

SNOW PACKING.

Packing in snow is a better way of keeping meat than freezing. The carcass should be cut into steaks, roasts, and boiling meat. All trimming for table use should be done before allowing the meat to freeze. Lay each piece out to freeze separately, where it will not come in contact with other meat. Secure a box large enough to hold it all and put a layer of dry snow at the bottom. When the meat is frozen put in a layer, packing it so that no two pieces touch. Cover this with a layer of snow and lay alternate layers of snow and meat until the box is filled. Set the box in an outside shed where it will not be subject to sudden changes of temperature. For convenience in getting the meat when wanted it is well to pack the steaks in one section or end of the box and the roast and stews in another. It will not then be necessary to disturb anything but the piece desired when a supply is needed. Use only dry snow in packing, be sure the meat is frozen solid, and it can then be kept through the winter unless there is a very warm spell. This method is applicable only to localities where snow and continued dry cold weather prevail during the winter months.

COOKING.

Partial cooking and packing in jars is also resorted to as a means of preserving meat in some localities. This method is applicable to a larger territory than either of the methods already given. It will be the most satisfactory in the keeping of pork in any instance. Slice the loin and side meat or any portion of the carcass desired and fry

until a little more than half done. Pack the slices as closely as possible in a stone jar and cover with hot lard. As the meat is wanted for use it may be removed from the jar and warmed up. If the jar is to stand for any length of time after it has been opened without using from it, it will be best to cover the top over again with lard. It is better to use several small jars than one large one. They should be kept in a cool, dark cellar to insure safe-keeping of the meat.

When meat is to be kept for only a few days a light coat of fine salt applied to the surface will be found sufficient if the meat is kept in a dark and comparatively cool place. Usually when meat is to be salted, however, it will be best to put it in brine of sufficient strength to preserve it for several weeks.

CURING MEATS.

Meat must be properly and thoroughly cooled to insure good keeping qualities when cured. If salted before the animal heat is out, the shrinkage of the muscles causes the retention of injurious gases, giving an offensive odor to the meat. Neither should meat be frozen when salted, as the action of the frost will prevent the proper penetration of the salt and uneven curing will result. It is important also that meat be cured as soon as cooled and while still fresh. Tainted meat may be cured so that it will keep, but nothing in the line of preservatives can bring back the natural flavor when it is once lost. The safest rule to follow is to salt meat as soon as the animal heat is out, and before it freezes or starts to decay. Ordinarily twenty-four to thirty-six hours after slaughtering will allow sufficient time for cooling.

VESSELS FOR CURING.

A clean, hardwood barrel is a suitable vessel in which to cure meat. A barrel made for this purpose is best, but where it can not be had a molasses or sirup barrel will answer.

A kerosene barrel that has been burned out and used for a water barrel for sometime is often used for a meat barrel. The important point is to have it clean and tight enough to prevent leakage. A large stone jar is the best vessel that can be had. One holding 25 or 30 gallons is expensive, however, and must be carefully handled to prevent breakage. The jar is more easily cleaned than a barrel, and is in every way preferable if the first cost can be afforded. A barrel or jar that has once held meat may be used again and again unless meat has spoiled in it. If used repeatedly, it will be necessary to scald it out thoroughly each time before packing with fresh meat.

PRESERVATIVES.

Salt, saltpeter, and sugar or molasses are the most commonly used preservatives, and are the only ones necessary for perfect curing and

the finest quality of cured meats. Borax, boracic acid, formalin, salicylic acid, and other chemicals are sometimes used in preserving meats, but they are considered by so many authorities to be harmful to the health of the consumer that their use should be avoided. The proprietary preparations put on the market are also likely to be dangerous to health if used in large quantities. They are more active than salt and saltpeter, and the chief reason for their use is to hasten the curing process.

Salt is an astringent, and when applied alone to meat renders it very hard and dry. Its action is first to draw out the meat juices. In a few days it will contract and harden the muscle fibers, thus shrinking the volume of meat. Saltpeter is even more astringent than salt. Its use aids in retaining the natural color of the flesh. In large quantities it is harmful to the health. Four to 6 ounces per 100 pounds of meat is as much as it is well to use. Sugar is not an astringent and its presence in the pickle softens the muscle fibers and improves the flavor of the meat. Saleratus (baking soda) is used in small quantities to sweeten the brine. In warm weather a small quantity will aid in preventing the brine from spoiling.

CURING IN BRINE AND DRY CURING COMPARED.

Brine-cured meats are best for farm use, for the reason that a suitable place for dry curing is not usually obtainable. It is also less trouble to pack the meat in a barrel and pour on a brine than to go over it three or four times to rub in the salt. The brining method also gives better protection from insects and vermin. Trouble is sometimes experienced in keeping brine, but if pure water is used and directions followed in making the brine there should be no difficulty in keeping it for a reasonable length of time. During warm weather brine should be closely watched. If it becomes "ropy," like sirup, it should be boiled or new brine made. A cool, moist cellar is the best place for brine curing. Dry-curing may be done successfully in a cellar also, though even more moisture is needed to effect a thorough cure. The cellar should be dark and tight enough to prevent flies and vermin from damaging the meat.

RECIPES FOR CURING.

CORNED BEEF.

The pieces commonly used for corning are the plate, rump, cross ribs, and brisket, or, in other words, the cheaper cuts of meat. The loin, ribs, and other fancy cuts are more often used fresh, and since there is more or less waste of nutrients in corning, this is well. The pieces for corning should be cut into convenient-sized joints, say 5 or 6 inches square. It should be the aim to cut them all about the same thickness so that they will make an even layer in the barrel.

Meat from fat animals makes choicer corned beef than that from poor animals. When the meat is thoroughly cooled it should be corned as soon as possible, as any decay in the meat is likely to spoil the brine during the corning process. Under no circumstances should the meat be brined while it is frozen. Weigh out the meat and allow 8 pounds of salt to each 100 pounds; sprinkle a layer of salt one-fourth of an inch in depth over the bottom of the barrel; pack in as closely as possible the cuts of meat, making a layer 5 or 6 inches in thickness; then put on a layer of salt, following that with another layer of meat; repeat until the meat and salt have all been packed in the barrel, care being used to reserve salt enough for a good layer over the top. After the package has stood overnight add, for every 100 pounds of meat, 4 pounds of sugar, 2 ounces of baking soda, and 4 ounces of saltpeter dissolved in a gallon of tepid water. Three gallons more of water should be sufficient to cover this quantity. In case more or less than 100 pounds of meat is to be corned, make the brine in the proportion given. A loose board cover, weighted down with a heavy stone or piece of iron, should be put on the meat to keep all of it under the brine. In case any should project, rust would start and the brine would spoil in a short time.

It is not necessary to boil the brine except in warm weather. If the meat has been corned during the winter and must be kept into the summer season, it would be well to watch the brine closely during the spring, as it is more likely to spoil at that time than at any other season. If the brine appears to be ropy or does not drip freely from the finger when immersed and lifted, it should be turned off and new brine added, after carefully washing the meat. The sugar or molasses in the brine has a tendency to ferment, and unless the brine is kept in a cool place there is sometimes trouble from this source. The meat should be kept in the brine from twenty-eight to forty days to secure thorough corning.

DRIED BEEF.

The round is commonly used for dried beef, the inside of the thigh being considered the choicest piece, as it is slightly more tender than the outside of the round. The round should be cut lengthwise of the grain of the meat in preparing for dried beef, so that the muscle fibers may be cut crosswise when the dried beef is sliced for table use. A tight jar or cask is necessary for curing. The process is as follows: To each 100 pounds of meat weigh out 5 pounds of salt, 3 pounds of granulated sugar, and 2 ounces of saltpeter; mix thoroughly together. Rub the meat on all surfaces with a third of the mixture and pack it in the jar as tightly as possible. Allow it to remain three days, when it should be removed and rubbed again with another third of the mixture. In repacking put at the bottom the pieces that were on top the first time. Let stand for three days, when they should

be removed and rubbed with the remaining third of the mixture and allowed to stand for three days more. The meat is then ready to be removed from the pickle. The liquid forming in the jars should not be removed, but the meat should be repacked in the liquid each time. After being removed from the pickle the meat should be smoked and hung in a dry attic or near the kitchen fire where the water will evaporate from it. It may be used at any time after smoking, although the longer it hangs in the dry atmosphere the drier it will get. The drier the climate, in general, the more easily meats can be dried. In arid regions good dried meat can be made by exposing it fresh to the air, with protection from flies.

PLAIN SALT PORK.

Rub each piece of meat with fine common salt and pack closely in a barrel. Let stand overnight. The next day weigh out 10 pounds of salt and 2 ounces of saltpeter to each 100 pounds of meat and dissolve in 4 gallons of boiling water. Pour this brine over the meat when cold, cover and weight down to keep it under the brine. Meat will pack best if cut into pieces about 6 inches square. The pork should be kept in the brine till used.

SUGAR-CURED HAMS AND BACON.

When the meat is cooled, rub each piece with salt and allow it to drain overnight. Then pack it in a barrel with the hams and shoulders in the bottom, using the strips of bacon to fill in between or to put on top. Weigh out for each 100 pounds of meat 8 pounds of salt, 2 pounds of brown sugar, and 2 ounces of saltpeter. Dissolve all in 4 gallons of water, and cover the meat with the brine. For summer use it will be safest to boil the brine before using. In that case it should be thoroughly cooled before it is used. For winter curing it is not necessary to boil the brine. Bacon strips should remain in this brine four to six weeks, hams six to eight weeks. This is a standard recipe and has given the best of satisfaction. Hams and bacon cured in the spring will keep right through the summer after they are smoked. The meat will be sweet and palatable if it is properly smoked, and the flavor will be good.

DRY-CURED PORK.

For each 100 pounds of meat weigh out 5 pounds of salt, 2 pounds of granulated sugar, and 2 ounces of saltpeter, and mix them thoroughly. Rub the meat once every three days with a third of the mixture. While the meat is curing it is best to have it packed in a barrel or tight box. For the sake of convenience it is advisable to have two barrels, and to transfer the meat from one to the other each time it is

rubbed. After the last rubbing the meat should lie in the barrel for a week or ten days, when it will be cured and ready to smoke. To cure nicely it is desirable to have a cool and rather moist place in which to keep it. This recipe should not be used where the meat must be kept in a warm and dry place, as the preservatives will not penetrate easily and uniformly.

HEADCHEESE.

Cut a hog's head into four pieces. Remove the brain, ears, skin, snout, and eyes. Cut off the fattest parts for lard. Put the lean and bony parts to soak overnight in cold water in order to extract the blood and dirt. When the head is cleaned put it over the fire to boil, using water enough to cover it. Boil until the meat separates readily from the bone. Then remove it from the fire and pick out all of the bones. Drain off the liquor, saving a part of it for future use. Chop the meat up finely with a chopping knife. Return it to the kettle and pour on enough of the liquor to cover the meat. Let it boil slowly from fifteen to thirty minutes. Season to taste with salt and pepper just before removing it from the fire. Turn it into a shallow pan or dish. Cover with a piece of cheese cloth and put on a board with a weight to make it solid. When cold it should be sliced thinly and served without further cooking.

SCRAPPLE.

This article of food is made just as headcheese is until the bones are removed and the meat chopped, when the liquor is added and the dish returned to the stove to boil. Corn meal is then stirred in until the contents are as thick as corn-meal mush. Stir it constantly for the first fifteen minutes, then set it back on the stove to boil slowly for an hour. When it is done pour it into a shallow dish to mold. When cold it is sliced thin and fried.

PICKLED PIG'S FEET.

Soak the pig's feet for twelve hours in cold water. Scrape them clean and remove the toes. Boil until soft; four to five hours will usually be required. Salt them when partially done. Pack them in a stone jar and cover with hot, spiced vinegar. They are served cold, or split and fried in a batter made of eggs, flour, milk, and butter.

TRYING OUT LARD.

Only the best of fat should be used for choice lard. Leaf fat is the best. The back strip of the side also makes nice lard, as do the ham, shoulder, and neck trimmings. Gut fat should never be mixed with the leaf and back fat. It makes a strong-smelling lard and should be kept separate. All scraps of lean meat should be cut out of the fat

before trying out, as they are very likely to stick to the kettle and get scorched, giving an unpleasant flavor to the lard. When preparing the fat for trying cut it into pieces from 1 to 1½ inches square. They should be nearly equal in size, so that they will try out in about the same time. Fill a clean kettle about three-fourths full and put in a quart of water, or, if convenient, a quart of hot lard. One or the other is necessary to prevent the fat from burning before the heat is sufficient to bring out the grease. Keep the kettle over a moderate fire until the cracklings are brown and light enough to float. Frequent stirring will be necessary to prevent burning. When done remove from the stove and allow to cool slightly, and then strain through a muslin cloth into a large jar. Stir it occasionally until it is cool enough to begin to solidify. If pails or smaller jars are to be filled the lard should be dipped out while just warm enough to be liquid. Stirring while the lard is cooling tends to whiten it and make it smoother. A quarter of a pound of saleratus added to each 100 pounds of fat has a like effect.

SAUSAGE.

Pork sausage should be made only from clean, fresh pork. To each 3 pounds of lean pork add 1 pound of fat. As the pork usually used for sausage is the shoulder, neck, and lean trimmings, the sausage is quite likely to be too fat unless part of the fat is removed and used for lard. Mix the fat and lean meat together in chopping. Where a rotary cutter is used it is best to cut the meat twice. After it is cut the first time spread it out thinly and season. One ounce of pure, fine salt, one-half ounce of ground black pepper, and one-half ounce of pure leaf sage, rubbed fine, to each 4 pounds of meat will suit the taste of most persons. The seasoning should be sprinkled thinly over the cut meat and the meat again run through the cutter to mix the seasoning thoroughly. This method will give a more even mixing of the spices than can be obtained by working it with the hands. For immediate use the sausage may be packed away in stone jars or crocks, to be sliced for frying. Many people stuff it into casings made from the small intestines of the hog. When this is done the intestines must be turned inside out and carefully cleaned.

Casings for sausage can be bought for about 3 cents a pound. At this price it will hardly pay to bother cleaning them for home use. The bought casings are more uniform in size and strength and will usually give better satisfaction. A good substitute for casings may be had in narrow muslin bags. These, when filled, should be 2½ or 3 inches in diameter and 18 to 24 inches long. Stuff the sausage in tightly by hand and hang in a cool place. If the sausage is to be kept for some time melted lard should be rubbed over the outside of the bag. This excludes the air. Sausage may be kept for some time in a large jar if a thin coat of lard is put over the top.

Mixed sausage may be made from a mixture of pork and beef in almost any proportion. It is the custom on many farms to kill three or four hogs and a beef during the winter for the year's supply of meat. When this plan is followed a nice supply of sausage can be made from the trimmings. Sausage should not contain too much fat. A good proportion is 2 pounds of lean pork, 1 pound of fat pork, and 1 pound of lean beef. Chop together fine and season the same as pork sausage. Pack in jars, muslin bags, or casings. Many people prefer this to clear pork sausage, as it is not so fat.

HAMBURG STEAK.

This is made from lean beef by running it through a sausage cutter. A very little fat should be added to the lean beef to make it juicy. It should be run through the cutter twice before using and salted slightly. A small amount of sugar-cured bacon is sometimes cut in with the beef to add flavor. Lean beef from the round makes the choicest Hamburg, but neck pieces, flanks, and trimmings are frequently used. Hamburg steak is not stuffed into casings, but left in bulk and made into patties for frying.

BOLOGNA SAUSAGE.

To each 10 pounds of lean beef use 1 pound of fat pork, or bacon if preferred. Chop finely and season with 1 ounce of salt to each 4 pounds of meat, 1 ounce of the best black pepper (ground, pure) to each 6 pounds of meat, and a little ground coriander. Stuff into casings called beef "middles" or beef "rounds." If stuffed into middles, make the sausages 10 or 12 inches long and allow them to hang straight. If stuffed into rounds make them 12 to 15 inches long, and tie the ends together so as to form rings. Smoke for ten or twelve hours. Cook in boiling water until the sausages float. Dry on clean hay or straw in the sun and hang away in a cool place until wanted.

CASINGS.

Sausage casings are the intestines of hogs, cattle, or sheep which have been emptied and cleaned. They are turned inside out and soaked in a solution of lye or limewater, thoroughly washed, and then salted down. When cleaned and put up by a reputable packer they are as good as when cleaned at home, and when they can be bought at a reasonable price it hardly pays to clean them for home use. The casings from different animals are used for the various kinds of sausages. Beef casings are of three kinds—"rounds," made from the small intestines; "bungs," made from the large intestines; and "middles," made from that part of the entrails leading from the bung to the rectum. The "rounds" are used for Bologna, the "bungs" for Bologna, ham, and blood sausage, and the "middles" for Bologna and

summer sausage. Hog casings are made from the small intestines of the hog, and are used mainly for pork link sausage. Sheep casings are from the small intestines of sheep, and are commonly used for wienerwurst and other small sausages.

SMOKING OF MEATS.

Pickled and cured meats are smoked to aid in their preservation and to give flavor and palatability. The creosote formed by the combustion of the wood closes the pores to some extent, excluding the air, and is objectionable to insects.

HOUSE AND FUEL.

The smokehouse should be 8 or 10 feet high to give the best results and of a size suited to the amount of meat likely to be smoked. One 6 by 8 feet will be large enough for ordinary farm use. Ample ventilation should be provided to carry off the warm air in order to prevent overheating the meat. Small openings under the eaves or a chimney in the roof will be sufficient if arranged so as to be easily controlled. A fire pot outside of the house proper with a flue through which the smoke may be conducted to the meat chamber gives the best conditions for smoking. When this can not well be arranged a fire may be built on the floor of the house and the meat shielded by a sheet of metal. Where the meat can be hung 6 or 7 feet above the fire this precaution need not be taken. The construction should be such as to allow the smoke to pass up freely over the meat and out of the house, though rapid circulation is at the expense of fuel.

Brick or stone houses are best, though the first cost is greater than if they are built of lumber. Large dry-goods boxes and even barrels may be made to serve as smokehouses where only small amounts of meat are to be smoked. The care of meat in such substitutes is so much more difficult and the results so much less satisfactory that a permanent place should be provided if possible.

The best fuel for smoking meats is green hickory or maple wood, smothered with sawdust of the same material. Hard wood of any kind is preferable to soft wood. Resinous woods should never be used, as they are likely to impart bad flavors to the product. Corn cobs are the best substitute for hard wood and may be used if desired. Soft wood and corn cobs give off large amounts of carbon in burning, and this is deposited on the meat, making it dark in color and rank flavored. Juniper berries and fragrant woods are sometimes added to the fire to flavor the meat.

FILLING THE HOUSE.

Meat that is to be smoked should be removed from the brine two or three days before being put in the smokehouse. If it has been cured

in a strong brine, it will be best to soak the pieces in cold water overnight to prevent a crust of salt from forming on the outside when drained. Washing the meat in tepid water and scrubbing clean with a brush is a good practice. The pieces should then be hung up to drain for a day or two. When drained they may be hung in the house. All should be suspended below the ventilators and should hang so that no two pieces come in contact, as this would prevent uniform smoking.

KEEPING UP THE FIRE.

A slow fire may then be started, warming up the meat gradually. During the winter months in cold climates it is best to keep the fire going continually until the smoking is complete, holding the temperature at about the same point. If the fire is allowed to die down, the meat becomes cold and the smoke does not penetrate readily. This results in heavy smoke on the outside and very little on the inner portions of the meat. During the spring months and in the summer a light fire may be started every second or third day for a couple of weeks, the meat being allowed to hang in the smokehouse until sufficiently colored. When the fire is kept going steadily and an even temperature is maintained, twenty-four to thirty-six hours will be required to finish one lot of meat. Smoke will not penetrate frozen meat and it will be necessary to extract all frost from it before filling the house. The house should be kept dark at all times to prevent flies entering. As soon as smoked sufficiently the meat should be cooled by opening the ventilators or doors. When hard and firm it may be canvased or packed away for summer use.

KEEPING SMOKED MEATS.

Smoked meat may be left in the smokehouse for some time during moderate weather. The house should be kept perfectly dark and well enough ventilated to prevent dampness. A dry, cool cellar or an attic with free circulation will be a satisfactory place for smoked meats at all seasons if it is kept dark and flies are excluded.

If to be held only a short time, hams and bacon will need only to be hung out separately without covering. For longer keeping it will be necessary to wrap them first in paper and then in burlaps, canvas, or muslin and bury them in a grain bin or other suitable place, the object being to gain a uniform temperature and to keep away insects. A coat of ground pepper rubbed into the piece before wrapping will be distasteful to them. For absolute safe-keeping for an indefinite period of time, it is essential that the meat be thoroughly cured. After it is smoked and has become dry on the surface it should be wrapped in parchment paper; or old newspapers will do where parchment can not be had. Then inclose in heavy muslin or canvas, and cover with yel-

low wash or ordinary lime whitewash, glue being added. Hang each piece out so that it does not come in contact with other pieces. Do not stack in piles.

RECIPE FOR YELLOW WASH.

For 100 pounds of hams or bacon take—

3 pounds barytes (barium sulphate);
0.06 pound glue;
0.08 pound chrome yellow (lead chromate); and
0.40 pound flour.

Fill a pail half full of water and mix in the flour, dissolving all lumps thoroughly. Dissolve the chrome in a quart of water in a separate vessel and add the solution and the glue to the flour; bring the whole to a boil and add the barytes slowly, stirring constantly. Make the wash the day before it is required. Stir it frequently when using, and apply with a brush.

BACON CURING ON THE FARM.[a]

By Loudon M. Douglas.

PIG FEEDING.

The great extension which has taken place during recent years in dairy farming has made pig breeding an important part of rural economy. It has been shown over and over again that no better food for raising pigs can be obtained than separated milk, provided that the butter fat which has been taken away is replaced by some other source of fat, and provided also that the milk is pasteurized. Milk in the complete state may be set down as the perfect food. If, therefore, it is found expedient to remove the fatty matter, very little knowledge will be necessary to devise means of restoring a fatty equivalent. Maize meal, together with potatoes, would seem to give the best results, and after that may be placed a mixture of barley meal and potatoes, mixed in either case with pasteurized, separated milk. The rules governing pig feeding can thus be reduced to great simplicity, a fact which is fully recognized. Farmers are at last taking to pig breeding seriously, as the agricultural returns clearly show. During 1902–03 the total increase in the pig population of the British Isles amounted to nearly 500,000, whereas in Great Britain alone the increase was 17 per cent over the previous year, or over 380,000. This is just as it should be. The long campaign waged against disease, by the Department of Agriculture has at last been successful, and farmers can with some feeling of security embark on this business. As the signs of disease become scarcer so also the supplies of pork products from the United States are reported short and unequal to the demand, even in that country.

CONDITIONS IN THE UNITED STATES.

It was from the United States that we received the bulk of our foreign bacon; and now that the population there increases so rapidly, while the available pig supply does not increase, it is clear that the exports of surplus bacon must grow less and less.

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[a] This article, which is copied from Farmer and Stockbreeder Year Book, 1904 (London), is an excellent supplement to a previous article by Mr. Douglas on the curing of bacon, which was published in the Annual Report of this Bureau for 1897. This article should be read in connection with the one entitled "Meat on the farm," immediately preceding this one.

The economic conditions of the United States are so adjusting themselves that we have to rely upon our own produce more and more. This is propitious for the future and means a large betterment of our rural conditions. We have for many years been relying to a large extent on the surplus pig products of other countries, owing to the fact that these were supplied to us cheap, and we have thus lost the art of making bacon on the farm. It is true that in some counties, notably Yorkshire and Dumfriesshire, home curing of bacon still lingers, but only in a perfunctory way. This is a pity and can easily be altered, for, after all, there is no difficulty in learning the business. A very ordinary amount of intelligence is all that is required.

CURING IN A SMALL WAY.

Farm buildings as constructed at the present day lend themselves to such an extension as bacon curing in a small way requires. There is usually a dairy, and it is so constructed as to be very cool. That is the one condition necessary for successful curing. Coolness must be provided above everything. More than three-quarters of a century ago Cobbett remarked: "Confined air, though cool, will taint meat sooner than the midday sun accompanied with a breeze."[a] It is difficult to agree with much that Cobbett writes, but in the statement given he surely could not have written more concisely a truth well recognized at the present day. Coolness is a necessary condition of good bacon curing, but it must be a fresh coolness. Now, it is easy to imagine such a place as part of the ordinary buildings of a farm. It is not necessary to excavate. The old notion that a cellar must be underground is exploded. You can get quite as low a temperature on the ground level if you are careful in your construction. You can, too, the more easily get fresh air when you want it.

A small establishment capable of handling a few pigs at a time would consist of a slaughterhouse, a cellar with curing beds and pickle tanks, and a smokehouse, and would cover a space of, say, 28 by 22 feet. It would be quite possible to do without a regular slaughterhouse, but such would undoubtedly be advantageous in many ways. We will assume therefore that a slaughterhouse will be provided. In it will be the necessary appliances, which consist of—

1. A windlass for hoisting the pigs to the sticking bar.
2. Singeing furnace.
3. Cold-water tank for cooling the carcasses after they are singed.
4. Track bar on which to dress and dismember the carcasses.
5. A few small tools, such as knives, saw, chopper, and also some convenient receptacles, such as pails.

Opening from the slaughterhouse will be the cellar. The walls, if constructed for the purpose, should always be built with a hollow space

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[a] Cottage Economy, ed. 1835, p. 116.

so as to prevent radiation as far as possible. Round three sides there should be a raised stone bench, having flagstones on the top. The

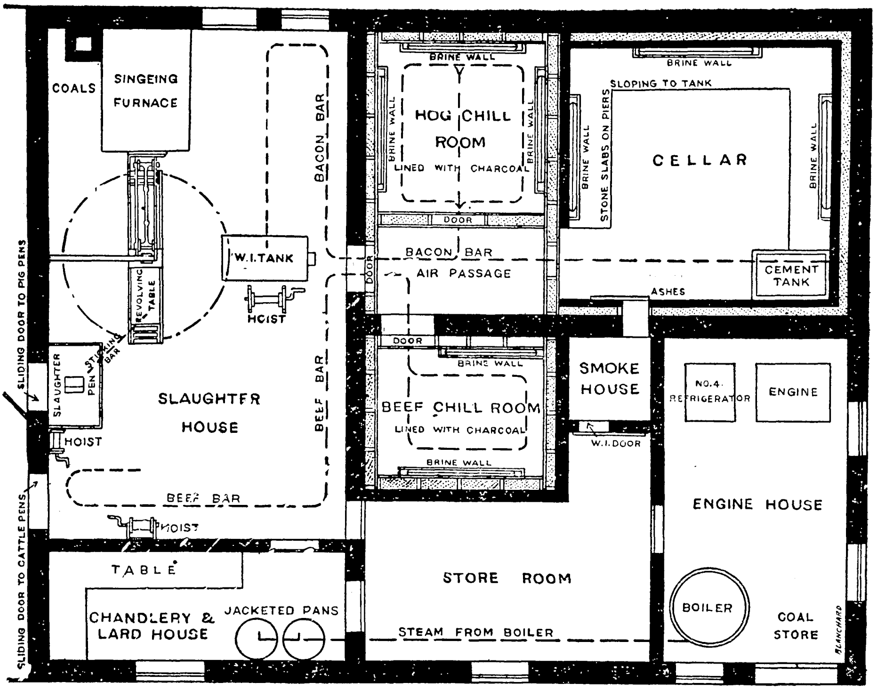


FIG. 57.—Plan of slaughterhouse.

width should be about 3 feet 6 inches, and not only should the flagstones be sloped downward from the front to the wall, but a channel should

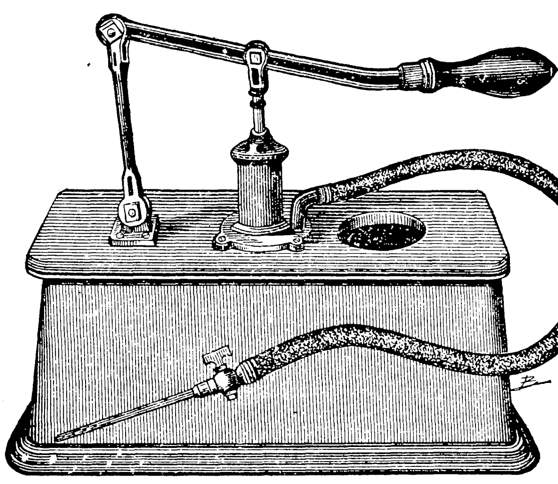


FIG. 58.—Pickle pump.

also be formed so that pickle when formed will run right round and discharge into a pickle tank at the far end. In the center of the place

a stone bench should also be constructed similar to the bench round the walls and sloped also in the direction of another pickle tank. The pickle tanks collect all the pickle which is formed in the curing, and this can be used either for pumping the bacon, or the tanks are used for containing heads, feet, houghs, etc., which are always cured in pickle.

SMOKING.

The smoke stove should have a few bars fixed at a convenient height, so that bacon and hams can be hung on them sufficiently above the fire not to get melted. The height of the cellar need not be greater than 7 to 8 feet, and, as has been indicated, it should be pretty solidly constructed. There need not be any windows, inasmuch as sunlight destroys the color of bacon. Any ventilation that may be necessary can be provided by means of an opening ventilator near the ceiling and which can be opened occasionally. The opening of the doors will, however, provide nearly all the ventilation necessary. The height of the slaughterhouse had better be somewhat greater than the cellar, say 18 feet, if possible, to the wall plate. The roof should be of corrugated iron with plenty of ventilation all round. There can not be too much freely circulating air in this department.

HANDLING THE PIGS.

In such a structure the process of handling the pigs is very simple. The pigs, having first been well rested in the adjoining pigpens, are driven one by one into the sticking pen, where a shackling chain is at once passed round one of the hind legs, and the animal is hoisted onto the sticking bar, hanging head downward. In this position a knife is passed quickly through the neck in the direction of the aorta, or main blood vessel of the heart, and quickly withdrawn. The blood at once rushes out, and in a very short time the animal is dead. It is then pushed along the bar and dropped onto the table of the singeing furnace, from whence it is carried by means of a little overhead trolley into the furnace itself. Here it rests for a quarter of a minute and is at once withdrawn and plunged into the cold bath alongside. From this it is raised, either by a windlass or by hand, onto the track bar, and is scraped by means of a flat scraper. (The pig is suspended by the hind legs by means of a gambrel passed through the sinews.) As soon as the black matter is removed by the flat scraper the carcass is washed by throwing a few scoopfuls of water upon it, and is opened and the offal removed. Each portion of this has a separate use and value, and great care should be taken so as not to waste any portion. The intestines should be cleansed and salted and used for sausage making. The heart and liver can be used as wholesome food. The lard should be hung up to cool and harden, and should be rendered down for domestic purposes. The kidneys and steaks are tidbits which can easily be disposed of.

WHEN THE OFFAL IS REMOVED.

The carcass when freed from offal should then be divided and the vertebral column removed. There will then be two sides, to one of which will be attached the head. This should be removed, as also should the fore feet. The sides should then be left hanging up to cool and dry. Usually this means hanging them till next morning, when, if the weather is cool, they will be ready to be put into salt and be cured. In the meantime such offal as the head and feet should be attended to. The head should be cut in two--the lower jaw removed from the upper. This, with the tongue still in it, should be cured in pickle and smoked. It is known as a "Bath chap." The top part of the head should be split in two and the brains removed. The two pieces should then be cured in pickle, and form a nice dish when cooked.

WILTSHIRE METHOD.

The main business is to cure the sides, and first of all for this purpose it is necessary to prepare a pumping pickle. This pickle is very important, as it is required for injecting into the meat, and consists of—

55 pounds salt,
5 pounds dry antiseptic,
4 pounds fine saltpeter,
1 ounce sal prunella,
5 ounces cane sugar,

made up to 20 gallons with pure spring water and stirred till all the ingredients are dissolved. Should it not become clear it will be necessary then to boil it and skim off the thick matter which will rise to the top.

The sides are cut down from the hanging bar and trimmed nicely; the sparerib is removed and the blade bone drawn out. The pumping pickle is then injected all over the fleshy parts, so that the meat is permeated at once with it. Immediately this is done the sides are laid on the curing benches and sprinkled over with an equal mixture of dry antiseptic and saltpeter. On the top of this is laid a heavy coating of fine salt, and the curing then begins. It is not necessary to touch the sides again for about fourteen days, when they will be cured mild and can be taken out, washed, and dried, if mild-cured meat is desired. For keeping meat, however, it will be necessary to replenish the salt at about the fourteenth day and leave it for another seven days anyway. This treatment will be necessary for sides weighing about 60 pounds each; for heavier sides a longer time in salt will be necessary, both for mild-cured and for long-cured meats. At the end of the cure the meat should be taken up and washed in cold fresh water, dried with a cloth, and hung up to dry. If wanted smoked, three days' smoking will be sufficient. Sometimes pea meal is dusted over the

sides before they are placed in the smoke stove; but this is a matter of taste. In any case they should be dusted over with some dry antiseptic, and some should always be dusted into the "pocket holes" so as to prevent any chance of their being attacked by taint or flies.

OTHER SYSTEMS.

The foregoing refers to what is commonly described as Wiltshire bacon. There are, however, many other ways of dealing with sides. They may be cut into sections and cured in separate pieces. Hams may be wanted, and in that case some modification of the process of curing would be necessary. The same pumping pickle would do, but it should not be pumped all over the ham, only into the blood vein, and that after the ham has been purged by resting in pickle overnight. The dry-curing process would then be the same as with bacon. With hams special care is necessary to have the shank low down and the cut surface raised. This insures the pickle sinking into the ham as it is formed.

Generally speaking, where hams and other products are made, there will be plenty of meat available for sausages. These can be prepared easily enough by means of the small hand sausage machines, which are obtainable everywhere. There are many recipes published for the making of these, but it is rather beyond the scope of this article to refer to them here. At the same time, it may be said that for a very trifling expenditure a complete sausage-making outfit is procurable, and whenever bacon curing on the farm is carried on not the least profitable part of the business will be the production of homemade sausages.

REINDEER AND CARIBOU.

By C. C. Georgeson, M. S.,

Special agent in charge of Alaska Agricultural Experiment Stations, Office of Experiment Stations.

The reindeer of Europe and Asia and the caribou of America are usually considered to belong to one and the same species, *Rangifer tarandus*, though some distinguished scientists recognize seven different species. For the purposes of this article they may be considered as one.

GEOGRAPHICAL DISTRIBUTION.

The reindeer constitutes one of the several genera into which the deer family is divided, and, considered from the standpoint of its usefulness to man, it is by far the most important member of this family. Its range in the wild state, though extensive, is confined to northern latitudes. On the American continent it is found from the shores of the Arctic Ocean along the Alaskan range, even below the boundary of the United States in the west, and in the east through Labrador to New Brunswick and Newfoundland, while on the plains it does not reach down so far. In Newfoundland, which is as yet but thinly settled, and the settlements located chiefly in the south and southeast portion of the Island, there are still large herds of caribou, which feed in summer on the barren highlands of the north and in winter migrate to the wooded districts in the south. Caribou, it is reported, are likewise still found in the hilly districts of New Brunswick and adjoining districts. In the interior of Alaska caribou is the most important game animal, though it is rapidly disappearing from the regions most frequented by the prospector and miner. In the Kenai Peninsula caribou are still found, but they are scarce. Its range is here almost identical with that of the moose. Both occupy the woods in winter and in summer both seek relief from mosquitoes by going to open ground, the caribou seeking the mountains, while the moose is more inclined to go to the grassy meadows along the seacoast to escape the pest. In the interior of Alaska there are still large regions unexploited where caribou are found in numbers, but they are scarce along the trails. In fact, they are nowhere numerous, except in the foothills of the range in which Mount McKinley is the principal peak. Small herds are scattered all through the northern plains of the continent to the Arctic Ocean.

In Europe it is found in the northern parts of Norway, Sweden, and Russia in the same regions as the domestic reindeer. In the Scandinavian range it extends well down toward the south, and in Russia it is said to be found throughout the whole length of the Ural Mountains, but not in the Caucasus. It is likewise found throughout the whole of northern Siberia and in the mountains as far south as latitude 52°. Reindeer are especially numerous in eastern Siberia, in Kamchatka, and in the region bordered by the Sea of Okhotsk, where they are largely domesticated. They have been imported into Iceland, where they have escaped from domestication and now run wild in great herds. They are found in Greenland, and, more wonderful still, in Spitzbergen, a group of islands in the Arctic Ocean nearly 400 miles north of Norway, stretching from latitude 76° 30′ to 80° 30′. Sportsmen have killed reindeer there by the thousand. This is, of course, a long way north of the northern limit of tree growth. The forest of more southern latitudes is here represented only by willows a few inches high. There are some flowering plants, but the principal vegetation consists of mosses and lichen, on which the reindeer feed. In short, the range of the reindeer and caribou is bounded by the isothermal line which determines the character of the vegetation on which they feed. They apparently prefer a species of lichen (*Cladonia rangiferina*), which for this reason is commonly called "reindeer moss," but they eat also other cryptogams, and they are very fond of mushrooms. In summer they browse much on willows and other brush, as well as grass.

In a former epoch the reindeer inhabited all of Europe, even down to the Mediterranean, having apparently been driven south by the advancing ice. Its remains have been found in France and elsewhere in continental Europe and in Scotland and in Ireland.

TWO RACES OF CARIBOU.

It may be noted here that in America there are two races of the caribou, commonly named after the range they occupy. One is called the Woodland caribou, and occupies the southern limit of the range; it feeds largely on grasses, and migrates southward in summer. The other, which is known as the Barren Ground caribou, follows the receding cold weather to the northward in summer, and goes to the woods, when it goes there at all, only in winter. The two differ in size, the northern type being the larger; they differ also in the antlers, which in the northern type are more palmated—that is, flattened—than in the southern type. These and other slight differences may be sufficient to separate the species—they are certainly varieties; but it is worth noting that no one thinks of erecting new species among our domestic cattle. And yet there are more marked differences between

a Jersey and a Galloway, for instance, or a Merino sheep and a Black-faced Scotch, or between a racer and a Shire horse, than between these groups of the reindeer.

DESCRIPTION.

Reindeer vary much in size. An abundant food supply is an important factor in their development, as in the case of other animals. Again, breed—perhaps we should call it race—characteristics are another factor influencing size. In some portions of Siberia the reindeer is much larger than in Lapland. Some domestic deer in that region stand 5 feet high, can carry 200 pounds on their backs, and are quite generally used for riding. There is more variation in size among the wild deer than among domesticated ones, the largest being found among the former; but, on the other hand, taking a large number, the domesticated deer will average larger than the wild.

Compared with other members of the deer tribe, it is not a graceful animal. The head is large, muzzle broad, neck short, set low, and usually carried horizontally. When the animal walks the top line of the neck is below that of the back. The withers are high, reaching above the line of the back; shoulders rather heavy, with prominent shoulder points, though when the animal is in good condition they blend pretty well with the thick base of the neck. The back is narrow, rump sloping; hind quarters light; flank low and quite full; underline nearly parallel with the back. In the fawns the legs seem disproportionally long, but in the mature animal they appear, on the contrary, rather short; the forelegs are straight, but the hind legs are crooked and spreading outward from the hock as if to brace the hind quarters and prevent their wabbling sidewise. The feet are large, and the hoofs spread when pressed against the ground—a provision of nature which aids the animal to get over soft snow or mud.

In color the caribou is grayish brown, darker in summer, lighter in winter; and while this, too, is the prevailing color of the domestic reindeer, the latter vary more than the wild ones, some being spotted, others almost white. All are lighter on neck, shoulders, and belly than on the back. The coat is exceedingly thick, longer in winter than in summer, and under the neck the hair is some 5 or 6 inches long, but there is no mossy undercoat such as most animals indigenous to arctic latitudes have. One peculiarity of the hair of the Alaskan caribou is perhaps worth mentioning, as I have not seen it referred to elsewhere, and that is that most of the hairs are more or less flattened, not cylindrical; the cross section is oblong, and in some cases they are as much as three times broader than thick. Moreover, the individual hairs are sinuous, the wave lines being on the edges of the hair, so that they do not appear wavy when viewed on the edge. The hair is

exceedingly brittle and breaks off readily when handled. For this reason caribou and reindeer skins do not make good rugs. They litter the floor continually with broken hair. The summer skins are better in this respect than the winter skins. The hide is thick and impervious to water to a marked degree, and by a certain mode of tanning practiced by the Lapps it can be made perfectly impervious. On the face and lower part of the legs the skin is particularly thick and durable, for which reason the Lapps use these portions for footwear.

A unique characteristic of the species is that both males and females have horns or antlers. They shed them annually in March and April, after which a new pair immediately start to grow. The young animal has cylindrical horns—nearly straight—which grow to a foot or more in length the first summer, but as it grows older the horns become palmated and curve outward and backward, and prongs, or branches, increase in number annually up to the age of seven or eight years. From that time the prongs decrease in number until in old animals there may be only a few points on the outer ends of the horns. In the prime of life one or both horns produce prongs which reach down over the face, called "brow antlers." The size of the antlers varies with the size of the animal. Antlers of females are smaller than those of males. Occasionally a pair of antlers is found measuring 4 feet in length and weighing as much as 40 pounds, but this is extreme; half of these figures more nearly represents the average. It is not easy to see just what function they fulfill in the animal economy. They appear to be a hindrance rather than a help in the struggle for existence. It must be a vast drain on the system to furnish nourishment for their rapid and prodigious growth, and they are tender and of little use for defense during the summer months while growing. They are at this season covered with skin, which is abundantly supplied with blood vessels and a fine coat of hair, when they are technically said to be "in the velvet." They are full grown about the time the breeding season begins in the fall of the year, and then the bulls use them freely on each other, but otherwise they are not often used for either defense or offense; instead, they strike their antagonist with their fore feet. The horn is soft, spongy, and not strong. Nor does the animal use the antlers in digging away the snow to reach the moss underneath, according to the observations of reindeer herders and others; this is done with the feet and nose.

The writer has not learned if any of the modern dehorning fluids have been used to suppress the growth of horns on domestic reindeer, but it would appear to be a subject worth experimentation. So far as known, the natural life of the caribou is about fourteen years, as is also the case with the reindeer. It does not reach its prime until six or seven years old.

DOMESTIC REINDEER.

We have no means of knowing when reindeer were first caught and tamed by savage man. They were doubtless first captured and confined with a view to having a food supply handy. Later he also found that his fleet-footed captive could be made to draw him over the snow, and this is as far as he has reached to-day. They have been domesticated for ages by the Laplanders, or rather by that portion of them who live a nomadic life, for most of the Lapps are fishermen and farmers. The reindeer is also domesticated by the Mongol tribes of Siberia, but to what extent is not fully known. It is known, however, that individual owners in that region hold herds of 15,000 animals or even more. One interesting feature of the deer in that region is that certain breeds or races of them are larger and much more powerful than the Lapland deer and, in consequence, are of greater service to man. This is especially true of the breed of deer kept by the Tunguse tribe in eastern Siberia. It was to introduce these large deer into Alaska that Lieut. E. P. Bertholf, of the United States Revenue-Cutter Service, visited Siberia in 1901 and, as we shall see, succeeded in landing about 250 head of them at Port Clarence.

The reindeer people, whether they live in Lapland or in Siberia, are all nomadic. They have to be. The deer, which live in large flocks, must be moved from place to place in search of pasture. The people consequently have no fixed abode, but live in tents, both winter and summer. They take the reindeer to the woods in winter and drive them to the mountains and open tundra in summer. Some of the people have log houses for winter use, located at various points on the range; others live in tents always. This is, of course, not conducive to a high state of civilization. Herding deer is in most respects like herding sheep. They must be kept together to prevent their straying off and becoming lost; they must be protected from wolves and other predaceous animals, and the sick ones and the fawns must be looked after. In return for this care the reindeer supplies nearly all the frugal wants of its owner. The meat is his chief food; from the milk he makes cheese, or in winter he keeps it in frozen chunks for use in coffee or for cooking, or it is evaporated and kept that way, or it is made into butter; the blood is saved and eaten; the fat is used for food, for candles, and for making footwear and clothing waterproof; the skins are used for tents, for clothing, for mats and blankets, for boots, for lassoes, for straps, and for thongs; the bones and horns are used for tools and utensils and, together with the hoofs, are used in boiling glue; and the animals are his burden bearers and motive power while they live. By the aid of the reindeer their owners maintain an existence where they otherwise would starve.

REINDEER IN ALASKA.

The name of Dr. Sheldon Jackson is inseparably connected with the introduction of reindeer in Alaska. It was due to his initiative that the work was begun and it is due to his persistent, unflagging efforts that it has been continued. When he first began his efforts were greeted with scoffing and ridicule. Elaborate arguments were advanced to prove that reindeer could not thrive in Alaska and that the attempt must end in certain and disgraceful failure. But he followed his plans undismayed. He succeeded at length in convincing Congress that it was the cheapest and easiest way of preventing the starvation of some thousands of Eskimos. Now the work has advanced so far as to prove beyond peradventure that reindeer will thrive in Alaska. The Eskimos are learning to handle them; the herds located in various places in the Territory are increasing fast; the white people who have seen the progress of the work have learned to appreciate the deer, and the voice of the scoffer is now but seldom heard. Some day a monument will be erected to Dr. Sheldon Jackson to commemorate this feature of his work and the benefits he thereby conferred on the natives.

The story of their introduction is most interesting. I will briefly note the salient points, derived chiefly from Doctor Jackson's reports on the subject.

Doctor Jackson visited arctic Alaska in 1890 for the purpose of establishing schools, a task which had been assigned to him by the Commissioner of Education. He found the Eskimos more in need of food than of schools. They were slowly dying of starvation and disease. Their condition had been changed for the worse by the influx of the white man. The relentless hunt of the whale and the walrus in steam vessels had largely reduced the number of these animals, or else they were driven beyond the reach of these poor people with the appliances at their command to pursue them. Thus their main food supply was lost. The fur animals had been hunted until well nigh exterminated, and the Eskimo could obtain but few furs to barter for food. The wild caribou, or reindeer, which had roamed over the tundra, were also killed off or driven away. Add to this the corrupting influence of the introduction of intoxicants and the vices of the white man, and it will be seen that their condition was pitiable.

In casting about for means to help them, it occurred to Doctor Jackson that the introduction of the reindeer would meet their wants. So soon as the deer were sufficiently numerous it would give them a permanent food supply and forever settle the question of starvation. He realized also that there were many and formidable obstacles to such a scheme. It was a task that it would take many years to accomplish, and the Government and people must be converted to the plan before it could be undertaken at all; and it meant that the modes of life of

REINDEER HERD, BARON KORF BAY, SIBERIA.

Illustration loaned by Dr. Sheldon Jackson.

Hobbling Reindeer for Loading on Ship.

Illustration loaned by Dr. Sheldon Jackson.

Freighting with Reindeer.

Illustration loaned by Dr. Sheldon Jackson.

the Eskimos must be changed to some degree from a hunting to a pastoral life.

On his return to Washington he advocated an appropriation by Congress for the purpose of purchasing reindeer in Siberia and transporting them to Alaska. The proposition was new; it took time to convince Congress of the practicability of the plan, and the first bills to that end failed to pass. Meanwhile Doctor Jackson, firm in his conviction, and with the approval of the Commissioner of Education, to whom likewise much credit is due for his cordial cooperation, appealed to the public through the press—described the condition of the Eskimo people and asked the aid of charitable persons to inaugurate his scheme. "The response was prompt and generous." He received something over $2,000, and by the aid of a revenue cutter in arctic waters, assigned by the Secretary of the Treasury to transport the deer, he proceeded to procure the first reindeer from the semisavage tribes in Siberia.

This first importation consisted of only 16 head. They were landed in Unalaska in the autumn of 1891. During the summer of 1892 he made five visits to Siberia and purchased and imported 171 head of reindeer. These were landed at Port Clarence, where, on the 29th of June in the same year, an institution for their breeding was established and named after Hon. H. M. Teller, Senator from Colorado, who had taken much interest in the enterprise.

In 1893 Doctor Jackson purchased in Siberia and added to the Alaska herd 127 deer, and 79 fawns were born to the herd already imported. In the same year Congress made the first appropriation for this work—"$6,000, to be expended under the direction of the Secretary of the Interior, for the purpose of introducing and maintaining in the Territory of Alaska reindeer for domestic purposes." Siberian herders were employed at first, but it was soon realized that the Lapps were the best teachers for the Eskimos, and so in 1894 seven Lapp herders were brought over from Norway. For their traveling expenses Doctor Jackson again had to call upon private beneficence. He also hired a superintendent of the work, Mr. W. A. Kjellmann, who proved himself most efficient. The work was now fairly started. Congress increased the appropriations as follows:

1894	$6,000	1900	$25,000
1895	7,500	1901	25,000
1896	7,500	1902	25,000
1897	12,000	1903	25,000
1898	12,500		
1899	12,500	Total	158,000

In the meantime there was a steady progress in the growth of the herd. Some importations were made every year except in 1896 and 1897. The average increase in the herd for ten years has been 42 per cent. This is not the percentage of the fawns born, but the percent-

age of fawns which lived through the year in which they were born. The following table gives a clear and concise view of the growth of the herd:

	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Total from previous year	......	143	323	492	743	1,000	1,132	1,877	2,538	2,792	3,464
Fawns surviving	......	79	145	276	367	466	625	638	756	1,120	1,654
Purchased during summer	171	124	120	123	......	......	161	322	29	500	30
Imported from Lapland	......	......	......	......	......	......	144	......	......	......	......
Total October 1	171	346	588	891	1,100	1,466	2,062	2,837	3,323	4,412	5,148
Sold, butchered, or died	28	23	96	148	100	334	185	299	531	948	......
Carried forward	143	323	492	743	1,000	1,132	1,877	2,538	2,792	3,464	......

This includes, among the killed for the year 1897, 180 deer driven to Point Barrow to feed the starving whalemen and 66 which were lost or killed on the way up there. I regret that I have no later data at my disposal; but from the above it seems safe to assume that on the 1st of October, 1903, there were 7,000 reindeer in Alaska. This is a remarkably successful showing; and even if no more were introduced, Alaska could be stocked from the present herds. At a rate of 40 per cent annual increase there would by 1910 be upward of 70,000 reindeer in Alaska. It is probable, however, that there will be a greater percentage of losses as the number increases for the reason that they must be scattered more and more among the inexperienced natives, who can not give them the same care they have so far had under Government supervision, and, with the increase, more will probably also be slaughtered for food. There should be no cessation in the importations for several years to come. It will take many years under the most favorable circumstances to fill the territory with all it can support. Doctor Jackson estimates in his report for 1895 that there are 14,000 square miles of deer pasture in Lapland, and that there are 23 reindeer to the square mile. On the same basis he also estimates that it will require 9,000,000 head to stock Alaska. Of course, this is only tentative. Lapland is more densely populated than Alaska is ever likely to be, and fewer deer will supply the wants of the people.

PRACTICAL TESTS.

The first notable example of the endurance of reindeer in Alaska and their adaptability to winter travel was a trip made in the winter of 1896–97 by W. A. Kjellmann while he was superintendent of the Teller Reindeer Station. He left Port Clarence in the middle of December, 1896, and traveled southward to the Kuskokwim River, about 1,000 miles distant, and returned to the station April 25, having accomplished 2,000 miles, through a rough and barren country, in

the worst season of the year, the reindeer obtaining their living from the moss which they dug out from under the snow.

The second practical demonstration of the value of reindeer was made in the winter of 1897–98, when a relief expedition in charge of Lieut. D. H. Jarvis, of the Revenue-Cutter Service, was sent overland to the shipwrecked whalers at Point Barrow. The expedition was a success, and the leaders in it, First Lieut. D. H. Jarvis, Second Lieut. E. P. Bertholf, and Surg. S. J. Call, were awarded gold medals and the thanks of Congress. On December 16, 1897, Lieutenant Jarvis and his companions started from a point some 300 miles south of St. Michael and proceeded northward, first with dog teams and later partly with reindeer and partly with dogs. Some distance above Nome the herd of a native, Charlie Antisarlook by name, was secured. Charlie had been an apprentice at the Government reindeer station and had become a skillful manager of the deer. At Cape Prince of Wales a herd of nearly 300 animals, belonging to private parties, under the management of W. T. Lopp, was secured, and Mr. Lopp volunteered to drive them to Point Barrow, a distance of 800 miles. They were to be used for food to succor the 300 whalemen who had been frozen in at that point without sufficient provisions. The hardships of this trip through a barren, unpeopled country, with the temperature from 20° to 50° F. below zero, and blizzards raging much of the time, can be better imagined than described. The undertaking was a success. That the deer could be driven through such a country in large number, find their own food, arrive safely at the destination, and there drop a large number of healthy fawns is evidence of the value of the reindeer to people who live in the Arctics. Dogs must carry their food with them; reindeer scrape the snow away and feed on the moss they find underneath. Numerous other tests have been made, though less severe. Reindeer have been employed to carry the mail for several winters between the settlements scattered along Bering Sea. In short, it has been proved to the satisfaction of every fair-minded person who has taken the trouble to post himself on the subject that reindeer are an unqualified success, both as a means of transportation and as a source of supplies for most of the necessities of life in that region.

TUNGUSE DEER.

In that portion of northeastern Siberia which is contiguous to the Sea of Okhotsk lives a tribe known as the "Tunguse people." Reindeer breeding appears to be their main industry, and their deer are of a much larger type than those found either in Lapland or Kamchatka. To introduce a stock of these deer in Alaska Lieut. E. P. Bertholf, of the Revenue-Cutter Service—the same gentleman who had accompanied Mr. Jarvis on the expedition to Point Barrow—was sent to Siberia

in the spring of 1901. He traveled from New York to St. Petersburg and 6,000 miles across Russia and Siberia to his destination. It was an eventful and interesting trip. A few quotations from his report to Doctor Jackson, published in the latter's report for 1901, will serve to give an idea of the kind of deer he was after and the way the natives use them:

These Tunguse deer were big fellows * * * and they stuck to their work steadily. Notwithstanding the difficulties, we made excellent time, and by 2 p. m. we had gone some 12 miles, including 7 miles of road breaking. Here we came upon a tea caravan of 40 sleds and 100 deer that had been stalled for three days by the storm. * * * The deer in this part of the country are very much domesticated and tame, and when they are allowed to feed the drivers never tether them but turn them loose to wander as they will. When ready for a start one man rounds the deer up and drives them to camp, where the rest surround them and inclose the herd with a long hide line, which is stretched along between the men. The animals stand very quietly while some of the drivers pick up the halter lines that have been trailing in the snow, and the deer are then led to the different sleds and harnessed. I never saw an occasion on our whole route when it was necessary to lasso a deer. When traveling the driver uses a switch with which to touch up a lazy deer.

Again he says:

The Tunguse deer are certainly magnificent animals, for they can carry a full-grown man several miles through very deep snow. In fact, when we were sighted from this camp, two Tunguse came out to meet us, riding deer that at times sunk in the snow nearly to the shoulder. The Tunguse who own reindeer do not remain long in one place, for they are of necessity wanderers, being obliged to shift camp frequently to keep their deer on good feeding ground. In these shiftings about the deer are utilized not only as draft but as pack animals, particularly when the snow is deep.

Speaking of their use for freighting, he says:

During the winter over 1,000 sleds leave Ola at different times, bound for Cemechan, in caravans of about 100 each. With a caravan of about 100 sleds belonging to one outfit there would be about 10 men, each man managing a train of 10 sleds, he driving the head team, while the other teams are tied by their halter lines to the sled in front. As each sled has two deer, and each train extra deer for emergencies, it will be seen that some 2,500 reindeer are used on this caravan route. Fifteen poods (540 pounds) per sled makes a total of at least 15,000 poods (270 tons); and as the difference between the cost of the deer caravans from Ola and the old horse caravans from Yakutsk, both bound to the same place, is $4 a pood, over $60,000 is saved to the Government yearly by the establishment of this deer caravan route from Ola to the Kolima River.

Concerning their use as pack animals, he says:

During my travel in the winter I had seen the reindeer used extensively with the saddle, especially in deep snow; but while I had noted their occasional use as pack animals, it was by no means general. Now, however, in the summer, I found they were used entirely as beasts of burden. In winter, when sleds can be used, two deer draw a load of from 15 to 20 poods, or from 540 to 720 pounds, thus transporting from 270 to 360 pounds per deer. That amount is not considered excessive, and the animals plod along with such a load day after day. When used as a pack animal, 150 pounds are considered the proper weight for the pack, though some animals can carry 200 pounds and more.

After much trouble Lieutenant Bertholf succeeded in purchasing 428 head of these large deer, and a ship was chartered to bring them to Alaska. However, owing to rough weather, 174 of these deer died or were killed on the voyage, and only 254 were landed at Teller Reindeer Station, Port Clarence.

TRAINING THE DEER.

Reindeer are naturally wild, and it takes much time, patience, and skill to train them so they can be handled without much trouble. Their wildness is in large measure due to the fact that they are usually bred in large herds, and individual animals are therefore not accustomed to be handled by the herders, who confine their attention in this respect to the few trained sled deer. The training begins when the deer is 3 years old. Generally the stoutest males and geldings are selected. Females are also trained, but they are smaller and less enduring. The training begins by lassoing the selected animals, thus separating them from the herd. The poor beasts are much scared, and jump about in frantic efforts to escape. The trainer advances hand over hand on the rawhide lasso till the head is reached. They are then sometimes given a little salt, of which they are fond; they are then led about for some time or tied to a post to accustom them to confinement and, the lesson over, again released. This is repeated day by day, and when sufficiently tamed they are harnessed and in the same manner gradually accustomed to draw light loads. This takes a long time and persistent work. They should not be worked before they are 3 years old. At 6 or 7 they reach their prime and then gradually decline.

In regard to driving them, Lieut. D. H. Jarvis makes the following observation in his report:

> All hands must be ready at the same time when starting a deer train, for just as soon as the animals see the head team start they are all off with a jump, and for a short time keep up a very high rate of speed. If one is not quick in jumping and holding onto his sled, he is likely either to lose his team or to be dragged along through the snow. They soon come down to a moderate gait, however, and finally drop into a walk when tired.

DEER HARNESS.

There are at least three ways of harnessing deer—one in Siberia and two in Lapland. Lieutenant Bertholf makes the following observation on the Siberian method:

> They are harnessed in pairs by a very simple arrangement—a plain loop of rawhide about 2 inches wide that goes over the off shoulder and between the fore legs. These loops are made fast to a single piece of rawhide that goes over the bent sapling on the front end of the sled runners, allowing it free motion. This makes both deer pull together, for if one gets ahead the other's hind legs hit against the sled and he is spurred on.

That is, the animal pulls by the left shoulder, the loop or strap referred to passing over the withers and between the legs, as when one ties a a sash over the shoulder. The trace is fastened at the right side, at the elbow of the right fore leg; the hind legs are thus both on the left side of the trace. The animal can not pull straight, but must of necessity advance somewhat sidewise. It appears like a barbaric and primitive, not to say cruel, way of working them.

Another method used in Lapland is not very different, but yet an improvement. A broad strap or rawhide is placed over the neck; the two ends being lashed together, they are drawn in between the fore legs and fastened to the trace, which passes out between the hind legs and is secured to the sled. The deer thus straddles the trace, and the pressure of the pull comes on the neck just in front of the shoulders and on the brisket.

A more modern style of harness is now also much used in Lapland. Lieutenant Jarvis describes it so fully that I will quote him again, this being the manner in which the deer he used on his Point Barrow trip were harnessed:

> They are harnessed with a well-fitting collar of two flat pieces of wood, from which a short trace goes back on each side to the ends of a breast piece, or swingletree, that fits under the body. [It is held up by a strap over the back.] From the center of this a single trace runs back to the sled, either between or on one side of the hind legs. In the wake of the legs this trace is protected with some soft fur, or the skin will be worn through with the constant chafing. Generally there is a single line made fast to the left side of the halter, and with this the animal is guided and held in check.

In Lapland, as in Alaska, there is seldom more than one animal hitched to a sled.

SLEDS.

The illustration (Pl. XVIII) shows two forms of the sled used in Alaska. The nearer sled in the picture was imported from Lapland and is there called a "pulka." It is a style which has been used in Lapland for centuries. It is about 7 feet long and 2 feet broad, pointed in front and square in the back, and generally rounded underneath so as to greatly resemble a boat. It has the desirable merits that it pulls easily and does not sink into soft snow. The front half is covered with deerskin stretched over bows. In this receptacle the baggage of the traveler is placed. A partition in the sled makes it a closed box. Access is had through a square hole in the top closed by a tight-fitting lid. In the back half of the sled is an upholstered low seat with back rest. It takes much experience to keep the seat, as the sled rolls from side to side. The other form of the sled is like the dog sled, or hand sled, in common use. It varies very much, as it is largely home-made. The one here represented is a common type; it is 9 feet long and 2 feet wide, built of thin slats to make it as light as possible, and inclosed by a railing about a foot high.

PLAN OF DISTRIBUTION OF DEER.

The object in introducing the deer is to familiarize the Eskimos with their use and to induce them to breed and to handle them. To this end the following plan has been adopted: The Teller Reindeer Station has been made the headquarters for the Government herd. A general superintendent and the other necessary employees have been stationed here. A number of expert Lapp reindeer men have been employed, who have the handling of the deer and also act as teachers to the Eskimos. The most intelligent young men from the various villages along the coast have been selected as apprentices to learn the art of breeding reindeer. They enter into an agreement to remain from two to five years or until, in the judgment of the superintendent, they have acquired sufficient skill to handle a herd. Meanwhile they are given rations and clothing and get a nominal pay in deer. If they show a lack of interest or are too dull to learn they are dismissed. When capable to handle them the Government will lend them a few deer, from which they can have the increase, but must return the original number loaned within five years. This gives them a nucleus for a herd. The Government also lends herds to mission stations on the same conditions. According to Doctor Jackson's report for 1902 there were then 60 individual owners of reindeer in Alaska, 44 of whom were Eskimos. Some of the mission stations have Lapp herders, who teach the natives, and where this is the case these missions become in effect powerful assistants to the Government. This appears to the writer to be an excellent plan. It helps the missions and at the same time hastens the acquisition of skill among the natives, which is a prime object. By lending deer to those natives only who have taken an interest in the matter and who have learned to handle them the danger of loss from carelessness is reduced to a minimum. The deer owners soon become important men in their respective neighborhoods and others will strive to emulate them. The ownership makes them independent of the ordinary methods of making a living; it teaches them self-respect and self-reliance. The deer also bring in money. The meat on one of them is worth from $50 to $100 at the mines and sled deer are worth upward of $100 each.

DISEASES OF REINDEER.

The reindeer is subject to several diseases, and it is very prone to accidents. In every herd, therefore, there is a certain annual percentage of losses which seem to be inevitable. One of its afflictions is known as the hoof disease. It begins with a lameness, followed by a swelling near the hoof, though the swelling may appear higher up on the leg or even on other parts of the body. The swelling is followed by the formation of pus, which may result in a running sore, followed

by gradual recovery after several months; or the disease may become systemic, when the animal usually dies. Dr. F. H. Gambell, superintendent of the Eton Reindeer Station, writes as follows on the subject:

> My belief is that the disease originates in the bones, generally near the articulation; that the inflammation is due to pus-producing germs which find lodgment in the devitalized bone; that gradually the pus "works" to the surface, causing an open sore; that at this time the trouble is localized, but later may become systemic.

Doctor Gambell has noticed a craving for calcium salts, and advances the theory that the disease is due to lack of vitality owing to the great strain upon the system to grow the antlers in so short a time. It might be inferred that giving them access to lime in some form would have a tendency to remedy the evil, but no experiments on that point are reported.

Reindeer are also subject to another trouble, designated as liver-and-lung disease, from which it appears many have died in the Government herd. No remedy has been reported.

They are prone to accident, and many deer break their legs, their necks, or their backs while running about or while fighting with each other.

IMPROVING THE BREED.

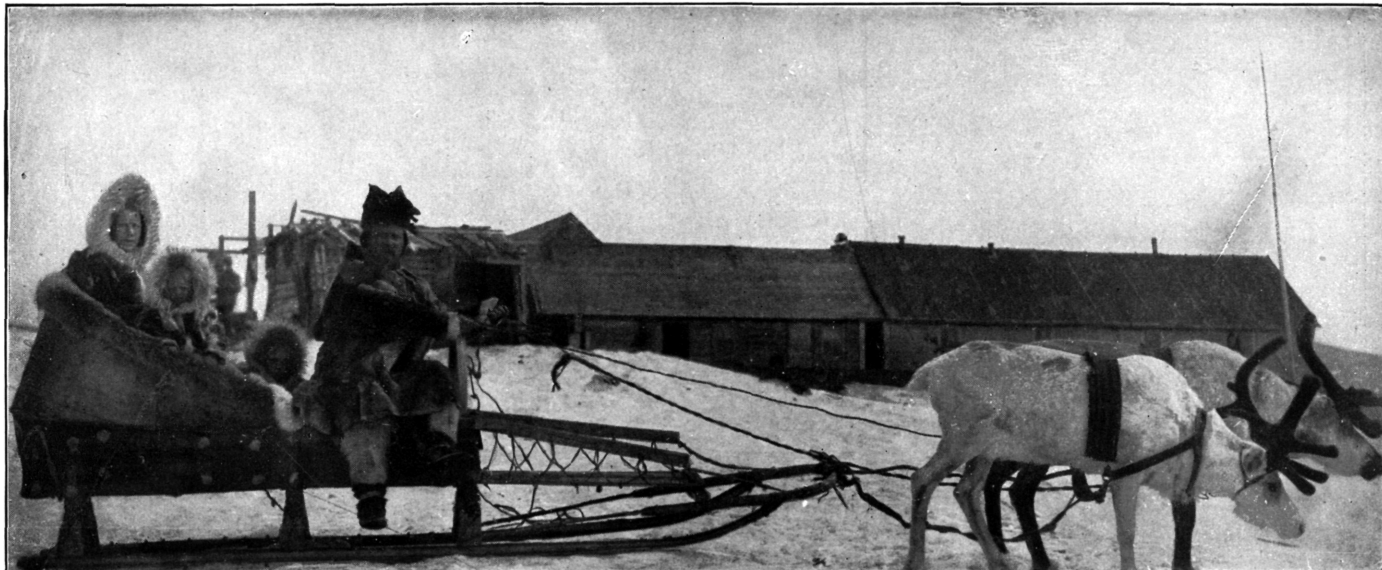
It appears to the writer that much could be done in the way of improving the size and strength of the animal, and therefore its usefulness, by breeding them up. The laws of breeding which hold sway in the development of cattle, sheep, and hogs must likewise be applicable in the breeding of reindeer. As has been noted, many of the wild deer are larger than the domesticated, probably because in the former case nature has applied her laws of the survival of the fittest, and the strongest males of the herd, as a rule, have become the sires of the herd. Under domestication these laws could be applied to even better advantage and doubtless with good results.

The abortion of the antlers, which under domestication are not only utterly useless but a decided disadvantage to the animal, is another line in which experiment might be tried with interesting results.

REINDEER AND AGRICULTURE INCOMPATIBLE.

The zone of the usefulness of the reindeer lies wholly outside that in which agriculture is possible. It lives chiefly on the lichen and herbage indigenous to the region where no agricultural plants will grow. It will not thrive in the warmer regions where agriculture is practicable, and it can not live on the kind of forage which we feed to cattle and horses. Wherever the ground can be cultivated its place will be taken by the horse and ox. But it is by far the most useful animal for the region north of the agricultural belt. It is the means of transmuting a vast amount of vegetation into meat and skins necessary to the support of the Eskimos.

Kinds of Sleds Used with Reindeer.



METHOD OF DRIVING REINDEER.

Illustration loaned by Dr. Sheldon Jackson.

REINDEER CARRYING PACKS.

Illustration loaned by Dr. Sheldon Jackson.

MILKING REINDEER.

Illustration loaned by Dr. Sheldon Jackson.

THE GOVERNMENT'S IMPORTATION OF CAMELS: A HISTORICAL SKETCH.

By Charles C. Carroll, A. M.,
Editorial Office, Bureau of Animal Industry.

In the early "fifties" the Government was sorely beset with difficulties in protecting the vast frontiers of the country from the ravages of hostile Indians. The transportation of men and supplies over the great reaches of plain, mountain, and desert that stretched between the Mississippi River and the Pacific coast was a problem that swallowed liberal appropriations of money and used up thousands of mules, and was in the end so poorly solved as to chafe and fret the spirits of successive commanders. The roving Indian, with his agile pony that enabled him to make deadly swoops on isolated settlements and escape with ease, was a continual nightmare to the War Department; while the unprotected condition of the Pacific coast, so remote and so painful of access, disturbed it no less. Under these circumstances it occurred to the military officials that the use of the camel might at least aid them in performing the difficult duties of protecting the expanding frontier and of keeping open a line of communication between the Mississippi and the coast.

The idea of transplanting this old servant of mankind from the East into America was not a new one. After the conquest of South America by the Spaniards, it is recorded that Juan de Reineza, a Biscayan, made an attempt to introduce camels into Peru, and toward the end of the sixteenth century camels were seen near the foot of the Andes by José Acosta, the Spanish missionary and writer. But the animals were not looked on with favor by the ruling Spaniards, and they dwindled away. In 1701 a vessel, probably a slave trader, brought some camels from Guinea to Virginia, but no record remains of the enterprise except that it failed. In the early times camels were brought also to Jamaica and employed there with success until a small insect, called the "chiqua," so we are told, got into their feet and ended their usefulness.

Maj. George H. Crosman was the first of our military men to consider and advocate the use of the animal for military purposes in this country, the transportation difficulties of our stubborn Indian war in Florida convincing him that camels might be used with effect. He made a study of the subject, and about 1836 brought it to the atten-

tion of the authorities. His ideas were taken up by Maj. Henry C. Wayne, whose studies on the subject were more complete, and who, as early as 1848, suggested to the War Department and to members of Congress the plan of a Government importation. At about the same time Jefferson Davis, then a United States Senator from Mississippi, was impressed with the desirability of trying the animals, and, as chairman of the Committee on Military Affairs, labored until he left the Senate (in 1851) to secure some practical test by the Government.

The suggestion that camels be used in this country for travel, for carrying the mails, and for transporting supplies is frequently met with in the newspapers of the "forties." These suggestions were made both by tourists from other countries, surprised at the wide extent of our territory, and by observant Americans who had traveled in the Orient and had become acquainted with the universal use of the animal throughout all of the eastern countries.

John Russell Bartlett, who was appointed in 1850 by President Taylor as a commissioner to run the boundary between this country and Mexico, on making the report of his three years' service in that work, strongly urged that camels be employed by the Government in the Southwest. At about this time, too, Prof. George P. Marsh, the philologist and diplomat, who served this country as minister to Turkey and to Italy, published an instructive book on the camel "considered with reference to his introduction into the United States," taking the ground that an energetic attempt to import and use these animals could not but result in success.

In the winter of 1852–53 the proposition was made to the Committee on Military Affairs in the Senate to authorize the Secretary of War to import 30 camels and 10 dromedaries, together with 10 Arabs to look after them, the proposal being supported by a paper of some length by Mr. George R. Gliddon, the archeologist, who had lived twenty-eight years in the Levant, and was, during eight years of that time, United States consul at Cairo. No measures were taken, however, by that Congress to provide for the importation.

When, in 1853, Jefferson Davis became Secretary of War in the Cabinet of President Pierce, he came more intimately into contact with the troubles of military transportation in our great West, and resolved to give the camel an opportunity to lessen these difficulties. Major Wayne was asked to prepare some remarks on the subject, to be used as the basis of an appeal to Congress, and he wrote a paper in favor of the project. This paper was liberally drawn upon by the Secretary when he submitted his annual report and recommendations in December, 1853. This report, which was transmitted with the President's message to Congress, aroused a good deal of interest on account of the general belief that something could be accomplished with camels in this country. After reciting the dangers of the slow

transportation between the East and the West, and giving in detail the result of an exploration which had been ordered by Congress for the purpose of locating the best route for a proposed transcontinental railway, Secretary Davis said that even such a railway, if built, would but partly remove the difficulty. It would serve to transport troops and to supply depots along the route and at the extremity of the line, but there would still be vast reaches in the interior too remote from its depots materially to feel its effect. "On the older continents," he continued, "in regions reaching from the torrid to the frozen zones, embracing arid plains and precipitous mountains covered with snow, camels are used with the best results." They carry all the commerce of central Asia, and have been used from the mountains of Circassia to the plains of India to transmit dispatches, draw ordnance, and as a substitute for dragoon horses. The example is cited of Napoleon who, by the use of the dromedary in his Egyptian campaigns, subdued the Arabs, a race "whose habits and country were very similar to those of the mounted Indians of our Western plains." Mr. Davis, therefore, believed that the dromedary would supply a want in the way of carrying expresses, making reconnaissances, and moving troops rapidly across country; and he recommended that "necessary provision be made for the introduction of a sufficient number of both varieties of this animal to test its value and adaptation to our country and our service."

The Secretary's recommendation did not bring results from that Congress, but it served to encourage those who believed that the camel would prove useful as a beast of burden in the United States, and a company was formed in New York, under a liberal charter from the legislature of that State, with the announced objects of importing and developing a number of camels of different kinds and of employing them in transportation in the West. The organization was styled "The American Camel Company," and its officers were William G. King, Charles W. Webber, and Edward Magouran, the last an enthusiast on the subject.

In his report of December, 1854, Secretary Davis, after again calling attention to the great sums expended for the transportation of men and supplies, said, "I again invite attention to the advantages to be anticipated from the use of camels and dromedaries for military purposes, and, for reasons set forth in my last annual report, recommend that appropriation be made to introduce a number of the several varieties of this animal to test their adaptation to our country." The committee that prepared the annual army appropriation bill seemed still skeptical, for the bill came to the Senate with no provision for camels. In this body an amendment proposed by Senator Shields, of Illinois, was attached, appropriating $30,000 "to be expended under the direction of the War Department in the purchase and importation

of camels and dromedaries to be employed for military purposes." In the House the proposition had for its sponsors Mr. Phelps, of Missouri, and Mr. James A. McDougall, of California, the latter venturing the prediction that the results of the experiment would "prove invaluable to the country." After the usual vicissitudes of amendments to appropriation bills, this proposition became a law in March, 1855.

Secretary Davis lost no time in beginning what he evidently expected to prove a most successful and far-reaching experiment. In May he directed Major Wayne to proceed to the Levant, stopping in England and France for the purpose of interviewing military men in those countries in regard to the camel and its uses in war. The Secretary of the Navy placed at the disposal of Mr. Davis the storeship *Supply*, with her crew, under the command of Lieut. David D. Porter (afterwards Admiral Porter), for the purpose of transporting the animals to this country. It was supposed that the climate of Texas would more nearly furnish such conditions as the camels were accustomed to, and it was accordingly ordered that they should be landed at the most convenient point in that State.

Major Wayne arrived in England in June, 1855. After inspecting the show camels at the zoological gardens in London and interviewing scientists and military men, he went to Paris, where he pursued the same course, obtaining considerable valuable information. He joined Lieutenant Porter and the *Supply* at Spezzia, Italy, June 24.

In the meantime Lieutenant Porter, having discharged his cargo of supplies for our Mediterranean squadron, and entering heartily into the spirit of the camel enterprise, had visited the farm of the Grand Duke of Tuscany, near Pisa, where camels had been bred and used for two hundred years. The original stock had come from Egypt, and a sufficient number were kept by the Tuscan ruler to perform the work of 1,000 horses. The animals were found to be performing hard work daily, being forced to carry loads as high as 1,300 pounds each, and toiling from sunrise to sunset. Despite this arduous service, they were badly treated by unappreciative keepers; were forced to obtain their entire subsistence by their own gleanings from nearly barren tracts of land covered with stunted pines and scanty grass, and were never housed, although the climate was hot in summer and cold in winter. The number was limited, but this seemed to be because the Grand Duke did not permit them to be used off his own estates.

In order that they might be able personally to study the animals, ascertain how the voyage would be likely to affect them, and how the arrangements they had made for embarking and stabling would work, Major Wayne and Lieutenant Porter determined to secure one camel at the first opportunity. They accordingly sailed directly for Tunis, where early in August they bought their first animal. Upon apply-

ing for a permit to bring it off, the Bey of Tunis graciously presented to the United States through them two other camels—one, at least, a fine animal, that subsequently became the veteran of the herd and proved himself a sturdy sailor, for he accompanied the ship for over 10,000 miles and was landed in good health on American soil nine months after his embarkation.

The voyage was resumed and Constantinople reached early in October. From this city the officers, leaving the ship, made a side trip to Balaklava, in the Crimea, to learn what they could about the camels that were used in the Crimean war. The English quartermaster gave them an opportunity of inspecting the animals in the possession of the English, and they gained much information which they regarded as pertinent and valuable. They were told that in the conquest of Sind some 25,000 camels had been used by Gen. Sir Charles Napier, an unusually acute student of transportation problems; and so satisfactory had they proved in the Crimea that the numbers on hand at Balaklava were to be increased for the next campaign. Here the Arabian,[a] or one-humped, camel was used almost exclusively. The average load was 600 pounds, carried 25 to 30 miles a day. A corps of 1,000 men mounted on 500 camels had rendered most effective service under General Napier. It was often marched 70 miles in twelve hours. On arriving at the desired point, the camels were left with the keepers and 500 men operated as infantry, the camels, kneeling and hobbled in a hollow square, even serving as a breastwork in case of necessity. The Bactrian, or two-humped, camel also was found at Balaklava, but, though stronger and heavier than the Arabian, was not so much used because of the difficulty of placing the load over his two humps and because slower in pace. Both officers were enthusiastic over what they saw and heard of the camel in the Crimea, Lieutenant Porter declaring that in the United States, at any point south of 36° (about the latitude of Raleigh, N. C.), the camel would be fostered with the greatest care, and that its value there for labor would be much greater than that of the horse. He expressed the hope that he might see the day when every Southern planter would be using the camel extensively, and he thought this not improbable, as a good work animal might then be imported from Smyrna for about $300.

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[a] The natural historians have generally designated the two-humped animal of this genus as the camel and the one-humped as the dromedary. After careful study and observation in the home of the animal Major Wayne disregarded this classification and speaks of it as of two distinct species—the Bactrian and the Arabian. The Bactrian has two humps; it came originally from Bactria and is now found more generally in Tartary and the northern parts of Central Asia. The Arabian has but one hump and is found principally in Arabia, Persia, Asia Minor, and India. The dromedary (Greek *dromas*, a runner) is simply a swift courser, or racer, as distinguished from the camel of burden (always, however, Arabian, or one-humped).

Two of the three camels procured at Tunis had shown symptoms of the itch; and, as it was feared that they might infect the ship with the disease, they were sold. Their lazy life on the vessel, coupled with good care and abundant food, had so fattened them that there was no trouble in finding a Turkish butcher, whose bid of $44 for the two was accepted. The Sultan, professing great interest in the experiment of our Government, offered to present 4 of his finest animals, but, as they had to be fetched from Asia, our officers deemed it imprudent to wait. Persia had been thought to be the best place to procure fine camels, but it was now so late in the season that the mountain passes were filled with snow and ice, and a trip to that distant country would have been difficult, if not impossible. So the *Supply* was headed for Egypt, arriving at Alexandria in December. Major Wayne journeyed on to Cairo, where he purposed buying 20 dromedaries. An unexpected obstacle was encountered in the "custom of the country." In order to avoid having all his good camels and horses sent out of his domain to supply the wants of the Eastern war, the viceroy had made a law that no animal of any kind should be exported, and it was with the greatest difficulty that he was prevailed upon to issue a permit, first for the exportation of 2 camels, then of 10. The last concession came too late, however, as, wearying of the slow processes of oriental routine (the negotiations being conducted in due form through the American consul), Major Wayne had determined to sail after loading but 3 camels. But now the viceroy himself had become interested in the experiment of the United States, and proposed to present the Government with 6 dromedaries. It seems to have been the intention of the ruler to present 6 of his finest beasts, and on learning of the proposed gift the major and lieutenant were aroused to the highest pitch of pleased anticipation, particularly as they had met with such ill success in their purchases and had been so worried by the unforeseen rules against exportation. They expected nothing less than a group of lithe-limbed, deep-chested racers of the best blood of Oman or Nubia—the flower of the royal herd, with pedigrees reaching back toward the beginnings of recorded time. After a week of impatient waiting, they were informed that the present of the potentate was in readiness in the palace yard, and, upon going to embark it, their chagrin was severe when, instead of the swift, well-kept dromedaries of the desert, they found a wretched half dozen of the commonest street camels of Alexandria, their hanging heads showing the spirit broken by ill usage, half denuded of hair by the itch, and loathsome from disease. Lieutenant Porter spurned the gift and took little pains to conceal his disgust. The viceroy's minister was informed of the miscarriage of his master's well-intended liberality, and the blame was laid on the rascally subordinates to whom the selection of the present had been intrusted; and, after another week of waiting, 6

fairly good camels were forthcoming. Thus, when the *Supply* sailed on January 22, 1856, she had on board 9 dromedaries and the Tunis camel.

Our officers reached Smyrna January 30, and, by having sent in advance Mr. Gwynn H. Heap, they were able to assemble rapidly the remainder of their shipment and prepare pack saddles and covers. This latter item was carefully attended to, as it was certain that properly fitting saddles could not be obtained in the United States. Mr. Heap's acquaintance with the languages and customs of the East, gained while serving as vice-consul at Tunis, enabled him to purchase the animals to the best advantage. Those he brought to Smyrna were bought at various points in the interior, the town camel being avoided, as it was generally infected with the itch caught from the streets and dirty khans. He appears to have paid as low as $100 for at least one animal and as high as $400 each for several others, the average price being about $250. No such fancy prices as $1,800 to $2,000 for a single animal were paid, although the idea was prevalent at the time in this country that the camels had cost the Government about $2,000 each. The prices, indeed, were found to vary, as do those of horses, according to breeding, size, training, and soundness, ranging from $15 to $1,000 and over. A sound burden camel capable of carrying from 400 to 600 pounds could be bought at $50 to $130, a dromedary at $45 to $1,000, the common stock bringing $45 to $150, and the swifter, purebred animals from $150 up. A good Tuilu, or Maya, brought $200, while two-humped Bactrian breeders sold at $300 to $600.

Lieutenant Porter solved, with his customary intelligence, the problem of loading the camels into the ship. He built first a boat 20 feet long and 7 feet wide, flat-bottomed so that it would easily slide up on the beach. He then constructed the "camel car," very strongly made and bound with iron, with a door at each end, and shaped to fit snugly into the boat. The camel was coaxed into the car, or, if he withstood coaxing and refused to enter, ten sailors with a block and tackle forced him in. The car, mounted on trucks, was then rolled down the beach and into the boat. The car weighed 1,000 pounds and by means of it the animals, averaging in weight 1,400 pounds, but going as high as 2,000 pounds, were loaded into the ship at the rate of one each half hour.

The home voyage was begun February 15, 1856, with 33 animals, as follows: Nine dromedaries, or runners, 23 camels of burden, and 1 calf. Among them were 2 Bactrian males (two humped) for use in breeding with the Arabian female. The offspring, called a "booghdee" (male Tuilu and female Maya), is always one humped and much heavier than the pure Arabian and on this account is greatly prized as a burden-carrying animal. Mr. Heap had picked up a fine Tuilu, an enormous fellow 7 feet 5 inches in height, 10 feet long, 9 feet 9 inches in girth,

and weighing when in good condition 2,000 pounds. Lieutenant Porter was obliged to cut a hole in the floor of the deck which served as the ceiling of the camel stable in order to accommodate this Tuilu's hump. Seven males were included in the load, the remainder being females, not counting the booghdee, which will not breed.

It was an interesting voyage home. The staunch little sailing craft met the most tremendous gales in the Mediterranean and was buffeted by unusually heavy weather during most of her trip across the Atlantic. It was often necessary, in order that they might not be injured by the tossing of the sea during the more violent storms, to tie the camels down in the position they assume when kneeling to receive their burdens, which posture they held for days at a time, eating and drinking much as usual and suffering no harm beyond a temporary stiffening of the joints.

The camels occupied a huge stable between decks. A thoughtful contrivance was a covered structure 60 feet long, 12 feet wide, and 10 feet high, which was placed on the upper deck, above the animals' quarters. Along the sides of this were placed at frequent intervals large portholes fitted with glass windows and heavy shutters. A hatch was provided in the top so as to let the animals down to their deck, and this aperture, being so far above the upper deck, could be kept open even during storms when it was necessary to close the portholes. Thus fresh air was assured in all kinds of weather—a very important matter on shipboard.

The success of this part of the experiment was due to the sagacity and watchfulness of Lieutenant Porter, who reduced the care of the animals to a military basis. He promulgated a set of "rules and regulations for the camel deck," requiring, among other things, that one person should always be on watch; the camels to be fed and watered every day at 3 o'clock precisely; the females having young to be fed and watered, in addition, at 7 o'clock in the morning; the deck never to be wet except by order; the hayracks to be filled every two days, and the amount of food to be kept account of; the camels never to be struck with anything but the flat of the hand; their beds to be littered down before sunset; each camel to be curried and brushed half an hour every day and their feet and legs to be well rubbed; their feet to be cleaned with soap and water twice a week; particular care to be observed in putting hay under their knees and haunches when they lie down; "the least thing the matter with an animal to be reported at once." The strictest cleanliness was exacted, the stalls being cleaned daily, and frequently whitewashed. The daily ration of food consisted of a gallon of oats, 10 pounds of hay, and a gallon of water to each animal, this being varied by occasional portions of crushed pease or barley made into a dough ball; salt was served once a week. The animals got along very well on this regimen, although

their natural diet consists of the leaves and tender branches of all kinds of trees and shrubs, while they have a special fondness for dried bushes of a bitter and astringent flavor and seem to consider prickly and thorny vegetation a dainty.

No experiments were made to ascertain how long the camels could go without water, and the information gained by the investigations of the expedition show that the tales on this subject are largely fables. The camel needs water each day, and gets along best when so supplied. He has a set of several stomachs, in one at least of which are cells where water is stored to the extent of about a gallon and a half, and this can be drawn upon when the animal does not get his daily supply. Habituated to traveling across the deserts, he has through the centuries developed the power of going from five to eight days without a drink, and nature has assisted him by giving him a skin so constructed that he perspires very scantily. But there is nothing in his supposed habit of drinking vast quantities of water and concealing it about his body for use in emergencies. His hump does, indeed, supply him with nourishment when at work where food is scarce, this being very well shown by the fact that during a long, hard trip this unsightly protuberance gradually decreases in size, so that it is necessary to change the length of the packing thongs acccordingly, until at the end of the trip the hump has almost entirely disappeared. The substance of the hump is pure fat. After a course of high living without work, the hump so increases in size that it is awkward to place a saddle on the animal. It is said to be customary then to slit the skin, lay it back, and cut off slices of fat. This fat has somewhat the appearance of thick cream and was said to be much esteemed by the Arabs, who use it in tea and coffee, but our investigators had no opportunity of testing it.

The strict regulation against wetting the camel deck was necessary, because the camel can travel over any kind of surface except one that is slippery. In Asia Minor, Syria, Persia, North Hindoostan, and Tartary he travels loaded across valleys and mountain ranges and deserts alike, exhibiting no hesitancy except when he encounters ice or mud. Here he loses control of himself, spreads his legs wide apart, and if not helped generally ends by the dislocation of shoulders or hips or by literally splitting himself up, an injury which is always fatal.

Six Arabs, one of them a Bedouin of the desert, were engaged to go along with the ship, with the idea that they would be useful in caring for the animals, but they proved helpless in bad weather, and their services were unnecessary in good weather. A Turk was also employed because he represented himself to be a "camel M. D.," perfectly familiar with the management of camels, their diseases and treatment. This gentleman turned out to be an Oriental Sangrado. His cure for a cold was a piece of cheese; for swelled legs, tea mixed with gunpowder; and for some further trifling complaint he gravely proposed

to tickle the animal's nose with a chameleon's tail. He was soon set aside by the common sense of Lieutenant Porter. In giving birth, one of the camels died, this being attributed to an injury received in loading. Two young ones, born soon after leaving Smyrna, were so much treated by the camel doctor that they also died; four others born during the voyage were kept out of his hands and would have come on very well, but one was starved because the mother could not be induced to rise and suckle it during a ten days' storm; another was accidentally lain on by an old camel and crushed. The other two were successfully reared, and, having the run of the camel deck, amused the whole ship by their friskiness and precocity; they were thoroughly at home in the worst of weather, perfectly steady on their legs, going about the deck without falling during gales that forced even the sailors to hold on to some support. Such remarkable seamanship was attributed to the fact that they were born at sea.

The show animals of the lot were two handsome dromedaries—one a Nomanieh from Oman, the other a Sennai from Nubia. Of all dromedaries the swiftest and most enduring is the Nomanieh, as it is also the best for riding, its natural gait being a movement of the hind leg and foreleg on opposite sides at the same time, or a movement of each leg in rapid succession. This gait must be taught to other breeds, as they naturally move in a rough trot. A good Nomanieh can travel from 90 to 100 miles a day, but can not keep such traveling up day after day. From fifteen to twenty days he can keep up a gait of 50 to 60 miles a day. Many stories are, of course, related of feats of endurance and speed, but these are to be taken with allowance. Our explorers found that the mail was regularly carried between Cairo and Suez on a camel. The distance is 84 miles and was covered in eighteen hours. The burden camel usually carries from 250 to 400 pounds, and travels regularly from 20 to 30 miles a day.

In the cargo were 4 Pehlevans—camels which had been taught to wrestle, a sport which is common in the East. It seems that without any training at all the animals engage in contests which are a sort of wrestling bouts. Whenever two males meet for the first time, especially if there are any females about, an encounter of this kind is indulged in. The camel that is thrown to the ground acknowledges his inferiority by scarcely daring thenceforward to look at the females. This natural propensity is cultivated by the Arabs and Turks, and the young camel is taught to wrestle, with some degree of science, by hoisting the right foreleg over the neck of his antagonist and coming down upon him with all the weight of the body. One of the Arabs employed by Major Wayne amused himself on the voyage by training "Uncle Sam," a month-old camel, to wrestle, a pastime at which he soon became so proficient and which he liked so well that it was found

necessary to tie him up, as he developed the trick of making sudden rushes at the men and throwing them to the deck.

It was in the midst of the rutting season when the animals were taken on board at Smyrna. At this period both sexes are cross and disposed to kick and bite. "The camel's kick is soft," says the Arab proverb, "but it takes life away;" its bite is not less terrible, as its heavy jaws and the leverage of its long neck enable it to pull and tear with great force. The females were exposed to the males constantly at this period with the purpose of securing as many young as possible at the earliest time. Except at this season, the camels were found, as a rule, docile and well behaved. The animal's patience is sometimes strained beyond endurance by the brutality of its drivers; at such times it displays some cunning in awaiting until the man is well within its power, when it takes summary vengeance. It appears to believe, however, with the American Constitution, that no man should be put in jeopardy twice for the same offense; and the driver who has mistreated a camel will place some part of his clothing where the beast may find it; and, after trampling and tearing the offender's coat, the camel is well satisfied and harbors no further grudge. When it does become necessary to discipline the beasts, our experimenters were cautioned that the punishment must be severe; they were instructed to take a heavy club flattened at the end and with this to strike the animal with great force on the left side of the neck about 6 inches back of the jaw and to keep up the beating until the refractory animal rolled on the ground in sign of submission.

Mr. Albert Ray, the keeper of the camels, who performed his work with sagacity and zeal, does not appear to have made any warm friendships among the animals, although they were individually named and kept track of in his journal, in the picturesque nomenclature of the Orient, as Gourmal, Adela, Mahomet, Massandra, Ibrim, Ayesha, and so on. Such friendships are common enough, however, among the Arabs, as the camel, when well treated, is inclined to become attached to his master, though perhaps to a lesser degree than the dog or horse.

By his intelligent and energetic care Lieutenant Porter thus kept his charges in excellent health, and landed safely at Indianola, Tex., May 14, 1856, 34 camels (a gain of 1 on the voyage), all apparently in really better condition than when taken from the sandy wastes of their native deserts.

After some days of rest the herd was marched by easy stages to San Antonio, Tex., about 120 miles, where Major Wayne set about making arrangements to establish a camel ranch and to attempt the breeding of the animals. His plans were interfered with by Secretary Davis, whose idea was to find out first whether or not the animals, in the language of his instructions, "were adapted to military service, and

could be economically and usefully employed therein," although he directed that they be given ample time to recover from their long voyage.

Some experimentation along this line was at once attempted. Major Wayne reported that, having removed his camp to Green Valley, 60 miles from San Antonio, he one day sent three 6-mule teams, with a wagon to each team, and 6 camels to San Antonio for a supply of oats. In going the camels were held back to accommodate themselves to the slower pace of the mules. Returning, the camels carried 3,648 pounds of oats, while the wagons brought 1,800 pounds each. Thus 3 camels were equal to 6 mules and a wagon, and, in addition, the camels came to camp in two and one-half days, while the mules were nearly five days in performing the journey.

One day at Indianola Major Wayne, who had been greatly annoyed by the skeptical attitude assumed by many persons throughout the country, and particularly by the jests of the unbelievers in the Texan town, thought to teach these latter a lesson. He brought up one of his finest pets, and, having caused it to kneel, ordered 2 bales of hay, weighing 314 pounds each, placed upon it. The knowing by-standers were convinced that the animal could not rise with such a load, but they laughed in scorn when the Major ordered 2 more bales piled on, making an aggregate weight of 1,256 pounds. To the amazement of all, and to the utter confusion of the scoffers, the camel, at the word of command, easily rose and walked off with his burden. This signal victory for the camel partisans created no little talk, and the incident was chronicled in verse by a local Texas poet, though unhappily, says Major Wayne, when he made his report, "I have not at hand a copy of the paper in which the ode was published," and it thus failed of official immortality.

"On another occasion," to use the language of Secretary Davis in his annual report of December, 1856, "the capacity of the camel for traveling over steep acclivities and on muddy roads was tested with the most satisfactory result. Instead of making the détour rendered necessary by the location of the road to avoid a rugged mountain impracticable for wagons, the camels followed a trail which passed directly ever it and, a heavy rain occurring while they were at the depot to which they had been sent for supplies, the road was rendered so muddy that it was considered impassable for loaded wagons. The train of camels were nevertheless loaded with an average of 323 pounds each and returned to their encampment, a distance of 60 miles, in two days, suffering, as it is reported, no interruption or unusual fatigue from the mud over which they passed or the torrents of rain which fell upon them. These tests fully realize the anticipations entertained of their usefulness in the transportation of military

supplies. The experiment of introducing them into the climate of the United States has been confined to the southern frontier of Texas. Thus far the result is as favorable as the most sanguine could have hoped * * * The very intelligent officer who was sent abroad to procure them, and who has remained in charge of them, expresses entire confidence both of their great value for the purposes of transportation and their adaptation to the climate of a large portion of the United States."

It should be noted that, in addition to this favorable opinion expressed by Major Wayne, that "intelligent officer," in his letters to the Department, placed especial stress on the comparison in usefulness between the camel and the mule, claiming superiority for the former and pointing out that the camel required less food and no more attention than the mule.

Something over $20,000 of the sum appropriated by Congress was yet unexpended, and in June Lieutenant Porter was furnished with $10,000 of this and directed to fetch home on the *Supply* another shipload of camels. The storeship then lay at New York, and, as food for the return trip, she took on board 150 bales (about 20 tons) of hay, 6,000 gallons of oats, 10 barrels of beans, 500 gallons of barley, 50 pounds of powdered sulphur, and 50 pounds of lard. The Department commissioned Mr. Heap at $2,000 a year and expenses and sent him on ahead directly to Smyrna, where, by the time that Porter arrived in November, he had collected from the interior a shipment of fine young animals. The Sultan of Turkey, through our minister at Constantinople, presented 6 dromedaries, which were included in this shipment. On the whole, this shipload was a much finer lot than those procured on the first trip. At Smyrna Lieutenant Porter employed nine men and a boy at $15 a month each and brought them along to help care for the animals. The Government continued to employ some of these men, together with some of those who were brought over on the first trip, for many years at $10 to $15 a month. One of them at least, Hiogo Alli, remained in the service as camel driver, interpreter, or mail carrier until 1870, when, on being discharged, he filed a claim for further employment on the ground that such was due him under the contract made in 1856.

Lieutenant Porter sailed for home November 14, and, although meeting the roughest weather he had ever encountered, he lost but 3 camels on a voyage of eighty-eight days, and was able to turn over to Major Wayne, at Indianola, February 10, 1857, 41 animals, all in fine condition. The new animals were taken to Camp Verde, which was now officially designated the camel station. Up to this time Wayne had lost 5 of his first herd—2 by Spanish fever (a disease incident to acclimation), 1 by epilepsy, 1 from the bite of a par-

ticularly ferocious companion, and 1 from blows probably inflicted by a mule driver who did not take kindly to the foreign beasts. The second shipload thus raised the camel herd to 70 in number.

In February, 1857, the Senate directed the Secretary of War to furnish it with a report regarding his camel experiment. This report was submitted the same month, and is a well-written and comprehensive document comprising the letters of Lieutenant Porter and Major Wayne, together with the information they had obtained and the conclusions they had drawn.

About this time the administration of President Buchanan came in and with it John B. Floyd as Secretary of War. Major Wayne, who had thus far conducted the camel experiment so vigorously and efficiently, was now transferred to the office of the Quartermaster-General at Washington, and could not, of course, give his personal attention longer to the Government camels, though he continued his interest in them, and was honored with a first-class medal from the Société impériale zoölogique d'acclimatation of Paris, for his successful introduction and acclimatization of camels into this country.

During the summer of 1857 the camels were used sparingly in carrying supplies and in short scouts. In the fall of that year Lieut. Edward Fitzgerald Beale, afterwards a brigadier-general, and also minister to Austria under President Grant, was employed to open a wagon road from Fort Defiance, N. Mex., to the eastern frontiers of California, and a part of the herd of camels was put at his disposal for this expedition. The journey occupied forty-eight days through an unexplored wilderness of forest and plain and desert, the Colorado River being reached October 18. Lieutenant Beale speaks in the most enthusiastic terms of the work performed by the camels on this arduous trip. He says that they saved the members of the expedition from many hardships, and excited the admiration of the whole party by their ability and willingness to perform the tasks set them. He started with the determination that the experiment should be most thorough, and subjected the camels to trials "which no other animals could possibly have endured." On the desert they carried the water for the mules; traversed stretches of country covered with the sharpest volcanic rock without injury to their feet; climbed with heavy packs over mountains where the unloaded mules found it difficult to go even with the assistance of the dismounted riders; and, to the surprise of all the party, plunged into rivers without hesitation and swam them with ease. The lieutenant concludes that he would rather have one of the camels for such work than four of the best of his mules. One of the men who had charge of the camels on this trip, writing home to the Richmond (Va.) Examiner, paints the same rosy picture of their entire docility and utility.

This and other favorable reports induced Secretary Floyd in his

annual report in December, 1858, to make some interesting comments. "The entire adaptation of camels," he says, "to military operations on the plains may now be taken as demonstrated." The beast, to his mind, had already proved its "great usefulness and superiority over the horse for all movements upon the plains or deserts," it would be of great value against the marauding Indians, and would materially reduce the expenses of the quartermaster's department in furnishing transportation. He recommended that Congress at once "authorize the purchase of 1,000 camels." So far was Congress from authorizing such a wholesale purchase, however, that it did not appropriate a cent, and a year afterwards, in December, 1859, the favorable reports continuing, the Secretary renewed his recommendation. He said:

The experiments thus far made—and they are pretty full—demonstrate that camels constitute a most useful and economic means of transportation for men and supplies through the great desert and barren portions of our interior. * * * An abundant supply of these animals would enable our Army to give greater and prompter protection to our frontiers and to all our interoceanic routes than three times their cost expended in any other way. As a measure of economy I can not too strongly recommend the purchase of a full supply to the consideration of Congress.

But that body could not, as so often happens, see the matter in the same light as the Secretary, and did nothing toward loosening the purse strings for this purpose. By December, 1860, the Secretary was still further confirmed in his opinion of the good work of the camels, and reiterated his recommendations of the two preceding years.

Secretary Floyd probably based his beliefs and recommendations largely upon the reports of Lieutenant Beale, for, after the successful trip of that officer from Texas to California to open a wagon road through the wilderness, the Secretary had placed twenty of the camels in his hands to be employed by him in national explorations. These expeditions were made over a large part of the Southwest, more particularly in the Rocky Mountains, and extended over a period of four years. During this time the animals rendered efficient service and were so well cared for by Lieutenant Beale that in 1861, with the incoming of a new administration and a new Secretary of War, he turned over to the Government quartermaster in California a herd of 28, all in good condition. For the next two years these 28, with several others that had been brought on from Texas, were held at the various forts and military stations in California, no one of the officers in charge appearing to be able to find any work for them to do. In 1862 Lieutenant Beale wrote to Secretary Stanton describing the idle and unfavorable conditions under which the animals were then kept, stating that instead of any natural increase since he had returned them, 3 of the finest had died, and proposing to take all of the remainder, give bond for their safe return at any time demanded, and to use them in further exploration and in packing supplies across

the great basin. At this time, he states, they were "of no earthly use either to the Government or anyone else," and the expense of their maintenance was about $500 a month. This proposition was rejected, and a year later a plan was set on foot by Deputy Quartermaster E. B. Babbitt, stationed at San Francisco, to employ the camels in carrying the mail between Fort Mohave, N. Mex., and New San Pedro (Wilmington), Cal. Objection was made to this plan by both Lieut. D. J. Williamson, commanding at the former place, and Capt. William G. Morris, at the latter, their reasons being based on statements entirely the reverse of those officially made by Major Wayne and Lieutenant Beale.

Acting on this unfavorable information, General Babbitt reported to the Department that for two years he had endeavored in vain to render the camels serviceable, and gave it as his conclusion that experience had proved "the inexpediency of substituting them for our native animals." At this time the animals in California numbered 35 in all, and were kept in the southern part of the State. The report of General Babbitt produced an order from the Department, on September 9, 1863, directing him to advertise and sell the camels at public auction. This was duly carried out, and the animals were purchased by Samuel McLaughlin, in whose care they had been for some time before.

It is probable that most of these camels found their way into menageries or zoological gardens. It has been supposed that some of them were taken to Nevada to be employed in packing salt from the deserts for use in silver extraction, but as the Nevada camels were of the two-humped kind, they probably came from a different source. In 1860 or 1861 a company was formed in San Francisco for the purpose of importing camels from Asia. They sent an agent to the high tablelands of Central Asia and procured about 20 Bactrian, or two-humped, camels, and from this herd came the 12 animals that were employed for some time in carrying salt from a marsh in Esmeralda County, Nev., to the Washoe silver mill, a distance of 200 miles. They performed this work satisfactorily, carrying, says Mr. L. Metral, of Virginia City, who packed them, an average of 600 pounds each, and traveling from 15 to 20 miles a day. The discovery of salt at a more accessible point deprived them of much of their occupation, although they remained in the vicinity of Virginia City for a number of years.

Professor Brewer, of Yale College, records that during a trip through the West, made about 1865, he saw a few of the animals near Virginia City. "Their backs," he says, "had not been cared for, and they had been used in packing heavy loads of salt from the deserts. Salt water and alkali had accumulated in the long hair of their humps,

their pack saddles had galled them, and great loathsome sores nearly covered the parts touched by the saddle. A pitiless snow squall was sweeping just then over this inhospitable region, and these miserable beasts, having fallen into bad hands in a bad climate, looked sadly enough." As late as June 28, 1876, the Virginia City Enterprise contained an account of an ascent of Mount Davidson made by a train of 8 camels, each carrying one-third of a cord of wood. The animals approached to within 150 feet of the summit, reaching an altitude of nearly 9,000 feet.

The historian H. H. Bancroft states that in 1876 the Nevada camels were all taken to Arizona, with the exception of one pair which, placed on a ranch in the Carson Valley, in a few years increased to 26. The story of the remarkable fecundity of this pair of camels spread far and wide, finding its way into Major Leonard's important work on The Camel, published in 1893, as well as into the encyclopedias. It should, however, be taken with great allowance, when it is remembered that the female camel gives birth but once in three years, and does not begin to breed until 5 years of age. The employment of the animals for practical purposes in Nevada steadily diminished. Their appearance on the public roads frightened horses, thereby giving rise to suits for damage, and leading finally to legislation prohibiting their use on the public highways and their running at large.

In the meantime the camels left at Camp Verde were employed in various errands to places over the State and became so common a sight on the streets of several towns that they ceased to excite curiosity. In some instances they were looked upon as a nuisance, because they frightened horses, and the city council of Brownsville is said to have passed an ordinance forbidding them the streets.

Thus they remained until the outbreak of the Civil War, increasing naturally to some extent, showing themselves well adapted to the climate and other conditions of Texas, and described in the papers of the day by those who saw them as healthy and strong, of greater stature and in all respects superior to the camels of the traveling menageries. At the beginning of the war the camel station passed into the hands of the Confederates, from whom the herd received scant attention, being allowed to pick up its own living by grazing. Naturally, some of the animals wandered away. Of these there is an official account of at least 3. These were captured in Arkansas by the Union forces and "sent to Mr. Paden, near the Des Moines River, in Iowa, for the benefit of his care and economy in their support." In June, 1863, Lieut. J. Grayler, from the headquarters of the Department of the Missouri, at St. Louis, asked the Department what he should do with them; the Quartermaster-General, on the ground that

the number was too small for use, recommended that they be sold at public auction, which action was accordingly ordered by Secretary Stanton.

Doubtless others of the herd during this period of loose discipline wandered off from Camp Verde and found their way westward to the deserts and mountains of the Texas Panhandle, of New Mexico and of Arizona, where they lived free and half wild, the prey of hunters both white and red. There are numerous recorded instances where soldiers or hunters have seen the animals and pursued them. These instances occur with decreasing frequency down to within the past ten years.

When at the close of the Civil War the Federal Government was again in charge of Camp Verde, all thought of making practical use of the camels was abandoned. The number was now 44, and in March, 1866, sealed proposals to buy them were invited. The bids were opened at New Orleans, at the office of the chief quartermaster, Col. E. G. Sawtelle. Three persons were willing to buy: Horace Bell offered $5 each; Joseph Hallam, $10 each; while Col. Bethel Coopwood's bid was $31 each. Gen. M. C. Meigs, Quartermaster-General, at Washington, reluctantly gave the order to sell at $31 each, expressing at the same time his belief that private enterprise would better develop the animal in this country and his regret that the experiment had failed.

The camels were delivered to Colonel Coopwood at San Antonio, Tex., and kept by him in that vicinity until December, 1866, when they were driven into Mexico. In January, 1867, 12 of them were sold to the proprietor of a "circus and caravan," and the remainder appear to have been, during the next fifteen years, disposed of in the same manner. As late as May, 1903, the Express, of San Antonio, speaks of having observed in one of the midway shows which had exhibited in that city a camel with the United States brand on it and the counterbrand of a subsequent purchaser. No doubt a search through the many menageries, traveling shows, and the zoological gardens of the country would reveal other survivors of the Government camels, although their number is likely to be few, as it is now more than thirty-five years since they passed from Government ownership, and the camel does not often, even with the best treatment, attain to more than 40 years.

Thus, after a checkered official life of eleven years, the camels passed finally into the hands of private owners. Of the two shiploads of animals, the Government retains nothing except the bones of one of the beasts, which stand in a case at the National Museum at Washington and perform the duty of illustrating to students the peculiar skeleton framework of the "ship of the desert," besides serving as a souvenir to those acquainted with the story of the attempt to transplant these ancient drudges from their homes in Africa and Asia to the Western

World. The camel in question, while at Fort Tejon, Cal., was killed by one of its mates that had gotten loose during the night. The animals were rutting and consequently intractable. The soldiers relate that the combat was most furious, the beasts striking each other resounding blows with their ponderous feet, while the drivers dared not interfere. The bones of the defeated animal were forwarded by Lieut. Sylvester Mowry to the Smithsonian Institution.

The most potent cause of the failure of the camel experiment was its interruption by the Civil War. Had Major Wayne been left in control of the camels which were imported under his supervision, and supplied with sufficient money to breed and increase them, as he so well knew was necessary, and had he been free to familiarize the teamsters and drivers with their management, there appears to be no particular reason why they should not have been of as much use in parts of this country as they were and are in the countries of the East. They were easily and quickly acclimatized and they performed with success their tasks in the initial experiments; indeed, so long as Major Wayne remained with them. But few officers understood their management, and they found in the mule driver an inveterate enemy. To secure their general use, a long course of experimentation, as well as teaching, was required. The beginning of the Civil War removed Major Wayne to the South, and during the succeeding years the camels were exposed to capture and recapture by the contending forces, neither of which had much time to devote to experiment. The construction of railways between the East and West, of course, limited the field in which it was proposed to use the camels, but they might still have been employed to advantage had anyone been found with the enthusiasm and information on the subject possessed by Major Wayne to collect and care for the scattered remnants of the herd and increase it to such numbers as might be of some real use. In idleness they were merely a useless expense to the Government and were very properly sold; but, as in the case of any unfinished experiment, it is to be regretted that the trial of the camel in the Western world was not carried to conclusive results.

MISCELLANEOUS INFORMATION.

Horses in Hawaii.—In an address on "Horses of the Islands, past and present," delivered at the second annual meeting of the Hawaiian Live Stock Breeders' Association, held at Honolulu, December 21, 1903, Mr. Julian Monsarrat discussed the history of horse breeding in Hawaii. Horses of the light breeds have been generally imported, large numbers being Thoroughbreds, which the writer regards as most useful in improving the native stock. Mr. Monsarrat states that there are at present in the Territory over sixty imported stallions of which he has record, but that this is probably below the actual number of these imported. The breeds include Standard bred, Thoroughbred, Arab, and Cleveland Bay. Some draft stallions have been imported, though the breeds are not stated, and even mustangs are used.

The greatest demand is for horses for road, carriage, and saddle purposes, the latter especially, including "cow ponies." The native stock is not regarded with very great favor, and the lack of good horses is ascribed not to a lack of good stallion stock, but to inferior brood mares, lack of good judgment in breeding, and improper methods of management. It is said to be customary on some ranches to allow stallions to run in the pasture with the mares from one year's end to another, with no feed but the pasture. In other cases mares and colts run together until the colts mature, with the result that colts frequently cover their dams.

Feeding the stallion well and keeping mares in good condition is advised. The Hawaiian climate is said to be very favorable to horses, many "crippled" trotters regaining form and condition after being sent to the Islands from the continent.

The zebrula v. the mule.—German papers say the mule will probably be replaced in the twentieth century by a more efficient animal, as it has been demonstrated that the mule—the cross between the donkey and horse—is inferior to the cross between the horse and zebra.

Formerly the opinion prevailed that the zebra was almost extinct. The opening up of Africa, particularly the eastern part, reveals these fine animals in large numbers.

Compared with horses and cattle, they possess peculiar advantages, as they are immune from the very dangerous horse disease of Africa, and also against the deadly tsetse fly. The question was therefore raised whether the zebra could not take the place of the mule, com-

monly used in the Tropics. The greatest credit with reference to the solution of this problem is due to Prof. Cossar Ewart, who has been trying since 1895 to produce crosses between horses and zebras, with a view to developing an animal superior in every respect to the mule.

Three species of zebras still exist in Africa: The so-called "Grevy" zebra, on the high plateaus of Schoa; the common, or mountain, zebra, formerly found everywhere in South Africa; and the "Burchell" zebra.

Professor Ewart produced crosses from mares of different breeds and zebra stallions of the Burchell kind. The offspring is called "zebrula," and on account of its form and general bodily condition—especially the hardness of the hoofs—is especially adapted for all transport work heretofore performed by mules. The zebrula is much livelier than the mule and at least as intelligent.

The Indian government has already experimented with zebrulas for transporting mountain artillery at Quetta.

In Germany much interest in this animal is manifested. The well-known Hagenbeck is experimenting in this direction and intends to introduce the zebrula into Germany and America. The zoological garden at Berlin possesses some very fine specimens. The zebra stripes are often well preserved, while the undertone of the skin is generally that of the mother. A full-grown zebrula is 14 hands high and the girdle circumference about 160 centimeters (63 inches).

The experiments so far have been so successful that it is predicted that the zebrula, during the present century, will completely supersede the mule.—(*Richard Guenther, consul-general, Frankfort, Germany, July 18, 1903.*)

Limousin cattle.—The following remarks are by Hon. Walter T. Griffin, United States commercial agent, at Limoges, France. Although the indorsement which he makes of the Limousin cattle is too sweeping for any breed, the paragraph is published for the bit of information which it contains:

> Attention has often been called to the Limousin cattle, there being no breed known that is so well adapted for beef as the hardy native Limousin stock. They far outrank the Durham or any other breed for this purpose. This breed is particularly robust, easily nourished and fattened, and has all the prime characteristics for producing first-quality beef. If these cattle were imported into the United States and crossed with native stock, they would improve the quality and be a great benefit to the producer. There is a registered herd book, and all information can be easily obtained.

Free entry of animals for breeding purposes.—Paragraph 473 of the tariff act of July 24, 1897, provides for the free entry of animals for breeding purposes under certain conditions relative to registry. The Board of General Appraisers at the port of New York, under date of December 20, 1902, decided that horses brought in under this section, if for sale, were dutiable. The same decision would apply to all other animals that might be imported in accordance with this section.

The effect of the decision was certain to prevent further importations, and therefore Hon. Charles Dick, of Ohio, introduced the following bill:

A BILL regulating the importation of breeding animals.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That paragraph four hundred and seventy-three of the act approved July twenty-fourth, eighteen hundred and ninety-seven, entitled "An act to provide revenue for the Government and to encourage the industries of the United States" (Thirtieth United States Statutes at Large, page one hundred and ninety-four), shall be so amended as to read as follows:

"473. Any animal imported by a citizen of the United States specially for breeding purposes shall be admitted free, whether intended to be so used by the importer himself or for sale for such purpose: *Provided,* That no such animal shall be admitted free unless purebred of a recognized breed, and duly registered in the books of record established for that breed: *And provided further,* That certificate of such record and of the pedigree of such animal shall be produced and submitted to the customs officer, duly authenticated by the proper custodian of such book of record, together with the affidavit of the owner, agent, or importer that such animal is the identical animal described in said certificate of record and pedigree: *And provided further,* That the Secretary of Agriculture shall determine and certify to the Secretary of the Treasury what are recognized breeds and purebred animals under the provisions of this paragraph. The Secretary of the Treasury may prescribe such additional regulations as may be required for the strict enforcement of this provision. Cattle, horses, sheep, or other domestic animals straying across the boundary line into any foreign country, or driven across such boundary line by the owner for temporary pasturage purposes only, together with their offspring, may be brought back to the United States within six months free of duty, under regulations to be prescribed by the Secretary of the Treasury: *And provided further,* That the provisions of this act shall apply to all such animals as have been imported and are in quarantine, or otherwise in the custody of customs or other officers of the United States, at the date of the passage of this act."

Approved, March 3, 1903.

The chairman of the Ways and Means Committee concluded a favorable report upon the bill with the following language:

Whatever may be the true construction of the subject to which the decision of the General Appraiser applies, it is perfectly apparent that Congress never intended to pass any bill or put any provision into a bill that would receive that sort of construction. It was the intention to improve the live stock of the country by the wisest possible legislation consistent with the idea of protecting the revenue against illegal and fraudulent importation; but to hold that an animal imported for breeding purposes could only be used by the importer and could not be sold is a practical repeal of the statute. We submit that the bill ought to pass.

An ordinance to protect horse breeders in the Northwest Territories.—The lieutenant-governor, by and with the advice and consent of the legislative assembly of the territories, enacts as follows:

SHORT TITLE.

1. This ordinance may be cited as "The horse breeders' ordinance." (1899, c. 20, s. 1.)

INTERPRETATION.

2. The expression "commissioner" means the commissioner of agriculture. The expression "department" means the department of agriculture. The expression "owner" includes a part owner.

3. Every person, firm, or company standing or traveling any stallion for profit or gain in the Northwest Territories shall cause the name, description, and pedigree of such stallion to be enrolled in the department, and shall procure a certificate of such enrollment as hereafter provided.

(2) No fee shall be required for such enrollment and certificate for any stallion registered under the provisions of chapter 20 of the ordinances of 1899, but in all other cases there shall be paid for such enrollment and certificate a fee of $2.

(3) Upon a transfer of the ownership of any stallion enrolled under this section the certificate of enrollment may be transferred to the transferee by the commissioner upon proof to his satisfaction of such transfer and upon payment of the fee of $1. (1899, c. 20, s. 2.)

4. The owner of any stallion shall post up and keep affixed during the whole of the season copies of the certificate of such stallion issued under the next preceding section in a conspicuous place both within and upon the outside of the main door leading into every stable or building where the said stallion stands regularly for public service.

5. The certificate issued for a stallion whose sire and dam are of pure breeding, and which is registered in a stud book approved by the commissioner, shall be in Form A in the schedule hereto.

6. The certificate issued for a stallion whose sire or dam is not of pure breeding shall be in the Form B in the schedule hereto.

7. The certificate issued for a stallion whose sire and dam are pure bred, but not of the same breed, shall be in Form C in the schedule hereto.

8. Every bill, poster, or advertisement issued by the owner of any stallion enrolled under this ordinance, or used by him for advertising such stallion, shall contain a copy of its certificate of enrollment. (1899, c. 20, s. 3.)

9. The production of any bill, poster, or other printed or written matter advertising any stallion for public service shall be prima facie evidence that such bill, poster, or other advertising material was used to advertise the stallion named and described therein by or with the consent of the owner or owners of the said stallion.

REGISTRATION OF LIEN FOR SERVICE.

10. The owner of any stallion holding a certificate of enrollment for such stallion under section 5 of this ordinance, or his agent, may file in the office of the registration clerk of the registration district for mortgages and other transfers of personal property in which the owner or person in charge of any mare upon which such stallion performs service resides, within twelve months after such service is performed, a statutory declaration setting forth—

1. The amount of service fee.
2. That the same is unpaid.
3. The fact of such service.
4. A reasonable description of such mare.
5. The name and residence of the owner of such mare.

(2) For filing such statutory declaration the registration clerk shall be entitled to a fee of ten cents. (1899, c. 20, s. 4.)

11. The owner of such stallion, upon filing such statutory declaration and complying with the provisions of this ordinance, shall have as a lien for the amount of said service fee and costs as hereinafter provided, upon the colt or filly, the offspring of any such stallion by reason of the service in respect of which such statutory declaration is filed, which lien shall take and have priority over any and all writs of execution, chattel mortgages, bills of sale, claims, and encumbrances whatsoever. (1899, c. 20, s. 5.)

ENFORCEMENT OF LIEN.

12. If payment of the service fee is not made before the first day of January in the year following the year in which the colt or filly is born, the owner of said stallion,

or his duly authorized agent, may at any time before the first day of May following take possession of the colt or filly upon which he has such lien as aforesaid, wherever the same may be found, and may proceed to sell the same by public auction after giving the person in whose possession the said colt or filly was when taken ten days' notice in writing of such intention to sell, which notice may be effectually given to such person by delivering the same to him personally or by posting it upon the door of such person's last-known place of residence in the Northwest Territories. (1899, c. 20, s. 6.)

13. The proceeds of sale shall be applied, first, in payment of the reasonable expenses of the taking of possession, giving of notice, and conduct of sale, not in any case to exceed $10 in all, and next in payment of said service fee, and the balance shall be paid forthwith by the owner of the stallion to the person from whose possession such colt or filly was taken. (1899, c. 20, s. 7.)

14. Violation of any of the provisions of this ordinance shall be an offense for which the offender shall be liable on summary conviction to a penalty not exceeding $25.

15. Chapter 20 of the ordinances of 1899 is hereby repealed.

16. This ordinance shall come into force on the first day of January, 1904.

SCHEDULE.

FORM A.—GOVERNMENT OF THE NORTHWEST TERRITORIES OF CANADA, DEPARTMENT OF AGRICULTURE.

Certificate of purebred stallion No. ——.

The pedigree of the stallion [name], described as follows: [Color], foaled in the year ——, has been examined in the department and I hereby certify that the said stallion is of pure breeding and is registered in a stud book recognized by the department.

—— ——,
Commissioner of Agriculture.

FORM B.—GOVERNMENT OF THE NORTHWEST TERRITORIES OF CANADA, DEPARTMENT OF AGRICULTURE.

Certificate of grade stallion No. ——.

The pedigree of the stallion [name], described as follows: [Color], foaled in the year ——, has been examined in the department and it is found that the said stallion is not of pure breeding and is therefore not eligible for registration in any stud book recognized by the department.

—— ——,
Commissioner of Agriculture.

FORM C.—GOVERNMENT OF THE NORTHWEST TERRITORIES OF CANADA, DEPARTMENT OF AGRICULTURE.

Certificate of crossbred stallion No. ——.

The pedigree of the stallion ——, described as follows: [Color], foaled in the year ——, has been examined in the department and it is found that his sire is registered in the —— and his dam in the ——.

Such being the case, the said stallion is not eligible for registration in any stud book recognized by the department.

—— ——,
Commissioner of Agriculture.

Numbers of live stock in United Kingdom.—The following figures, showing the numbers of live stock for the United Kingdom for the year 1903, are from the "agricultural returns" (official) of Great Britain:

Numbers of live stock in the United Kingdom, 1903.

Country.	Cattle.	Horses.	Sheep.	Hogs.
England	4,746,308	1,179,360	14,900,978	2,305,807
Wales	711,064	157,264	3,511,424	243,983
Scotland	1,247,246	200,530	7,227,395	136,771
Ireland	4,664,168	523,850	3,944,581	1,383,472
Isle of Man	39,774	8,968	74,462	15,731
Total	11,408,560	2,069,972	29,658,840	4,085,764

There was a gain for all kinds of live stock during the year, except for sheep, in which case there is an apparent loss of 397,791. The returns for the years 1900 to 1902 may be found on page 477 of the Nineteenth Annual Report of this Bureau, and those for the years 1891 to 1899 on page 442 of the Sixteenth Annual Report.

Imports and exports of animals and animal products of Germany.—According to Hon. Frank H. Mason, consul-general at Berlin, Germany (Consular Reports, January, 1904), the principal imports and exports of animals and animal products for the year 1902 were as follows:

Principal imports and exports of animals and animal products in 1902.

IMPORTS.		EXPORTS.	
Wool	$76,088,600	Woolen goods	$63,522,200
Eggs and egg yolk	27,393,800	Woolen yarn	14,875,000
Lard and fats	26,108,600	Leather	16,612,400
Horses	21,991,200	Cattle hides	10,186,400
Cattle hides	21,896,000	Total	105,196,000
Woolen yarn	20,611,800		
Total	194,090,000		

Elsewhere in this report, under the head of "Imports and exports of animals and animal products," a statement will be found of the kinds and quantities of imports into Germany of animals and animal products from the United States.

Number of animals in India.—The report of animals of British India for the year 1901–02, gives the following statistics:

	Number.
Bulls and bullocks	28,366,260
Cows	20,940,702
Buffalo bulls	3,280,425
Buffalo cows	8,853,616

	Number.
Calves (including buffalo calves)	23, 854, 207
Sheep	17, 736, 199
Goats	19, 296, 718
Hacks and ponies	1, 309, 189
Mules and donkeys	1, 222, 377
Camels	383, 176

For the native states the following are given:

Cattle and buffaloes	8, 580, 348
Sheep and goats	5, 732, 795
Horses, mules, and donkeys	118, 598
Camels	42, 589

Live stock in Algeria in 1902.—The number of live stock in Algeria in 1902 is reported in the following table:

Live stock.	In European possession.	In native possession.	Total.
	Head.	*Head.*	*Head.*
Horses	48, 700	276, 000	324, 700
Asses and mules	45, 100	395, 000	440, 100
Beeves and cows	148, 500	925, 300	1, 073, 800
Sheep	447, 700	8, 277, 000	8, 724, 700
Goats	75, 800	4, 181, 000	4, 256, 800
Hogs	78, 200		78, 200
Camels		189, 200	189, 200

Prices of fat sheep in Australia.—The following prices of fat sheep in Australia are quoted from the Australian special correspondent for the American Sheep Breeder:

Prices of fat sheep in Australia in 1903.

Prime wethers	$4. 32 to $5. 34
Good Merino wethers	3. 84 to 4. 16
Prime crossbred wethers	4. 48 to 5. 04
Good crossbred wethers	4. 08 to 4. 32
Prime lambs	3. 72 to 3. 96
Good lambs	3. 36 to 3. 60
Medium lambs	1. 92 to 2. 88

These prices may be compared with Chicago prices for the same year by reference to page 680.

During the year of 1903, 1,785,000 sheep were brought to the Sydney sales yards from the country districts; in 1902 the number was 2,394,000. The decrease was due to the severe drouth which prevailed in 1902.

Number of sheep in New Zealand in 1903.—The number of sheep reported in New Zealand in April, 1903, according to a report recently

published, was 18,954,553, which shows a reduction from 1902 of 1,388,174. The decrease is attributed to a great increase in exports of mutton carcasses.

Argentina wool statistics.—The raw wool exported from the Argentine Republic from October 1, 1902, to July 3, 1903, together with the points of destination, was as follows:

	Bales.
Dunkirk	187,642
Antwerp	56,919
Hamburg	97,181
Bremen	40,093
Genoa	5,446
United Kingdom	28,807
United States	21,623
Bordeaux	119
Havre	7,310
Marseilles	1,167
Rotterdam	2
Total	446,309

The exports for the season 1901–02 comprised 434,283 bales. The figures for 1901–02 include 17,000 bales of the 1900–1901 clip.—(*D. Mayer, consul, Buenos Aires, Argentine Republic, July 11, 1903.*)

Consumption of wool in England.—A gentleman writing for the American Shepherd's Bulletin for October, 1903 (p. 1319), says that the estimated consumption of sheep and lambs' wool of the United Kingdom went from 313,000,000 pounds in 1856 to 494,000,000 in 1902, or from 10.4 to 11.8 pounds, respectively, per head of the population. The average annual consumption of raw wool in the United Kingdom is also estimated, and the table is reproduced herewith, together with an estimate of the domestic clip:

Estimate of domestic clip and average annual consumption in United Kingdom for the years 1870–1899.

Period.	Annual domestic clip.	Total annual consumption.
	Pounds.	*Pounds.*
1870–1874	160,000,000	342,000,000
1875–1879	155,000,000	353,000,000
1880–1884	135,000,000	354,000,000
1885–1889	135,000,000	416,000,000
1890–1894	146,000,000	475,000,000
1895–1899	138,000,000	523,000,000

Wool sales and wool prices in Australia.—The Australian special correspondent of the American Sheep Breeder gives the figures

quoted herewith for the sales of wool in the Australian markets for the last six months of the years of 1902 and 1903, and also the prices of the different kinds and grades of wool for 1903:

Wool marketed in Australia.

Market.	1902.	1903.
	Bales.	*Bales.*
Sydney	177,540	194,786
Melbourne	142,797	119,386
Geelong	80,138	72,386
Adelaide	58,146	57,232
Brisbane	7,930	14,916
Tasmania	8,000	....
Total	474,551	458,706

The decrease of 15,687 bales (of 300 pounds each) is explained by the fact that no sales were held in Tasmania during Christmas week.

The following table shows the prices of wool of the various grades that obtained in 1903:

Prices of wool (per pound) in Australia in 1903.

Kind of wool.	Superior.		Good.		Medium.		Inferior.	
	Cents.		*Cents.*		*Cents.*		*Cents.*	
Greasy Merino:								
Fleece	23	to 29	20	to 22	17½	to 19½	11½	to 17
Pieces	20	24	18	19½	14½	17½	8	14
Bellies	15½	19	13	15	11	12½	8	10½
Lambs	20	22	16	19½	12	15½	6	11½
Locks	8	10	6½	7½	5	6	3	4½
Crossbred:								
Fine	21	24	18	20½	16	17½	13½	15½
Coarse	13	15	11½	12½	10	11	8	9½
Scoured Merino:								
Fleece	42	49½	38	41	34	37½	29	33
Pieces	38	41	34	37½	30	33½	22	29
Bellies	34	39	30	33½	25	29½	20	24
Locks	24	29	20	23½	18	19½	14	17½
Lambs	36	40	32	35½	26	31½	20	25

The wool-combing industry of Bradford, England.—It has been well said that the foundation of Bradford is wool. It has grown out of wool, as Manchester grew out of cotton and Pittsburg, Pa., out of iron. In Bradford are centralized the industrial and commercial activities in wool and wool products in Great Britain. Probably 80 to 90 per cent of all the wool manufactured or partly manufactured in England is at some stage the subject of a bargain on the Bradford exchange or in some Bradford merchant's warehouse. Several phases of the industry appeal to those connected with the wool industry in other

parts of the world; hence a few facts concerning one leading branch may be of interest to our manufacturers.

WOOL COMBERS' CRISIS.

The wool-combing industry is passing through a serious crisis, but the verdict is general that when the commercial atmosphere is cleared and the trade put on a firm footing conditions will be all the more sound because of the present winnowing process.

American textile readers in general know that in the autumn of 1899 a wool-combing trust was formed, comprising 38 firms of commission wool combers and top makers, three other firms having since pooled their interests. The authorized capital of the association was: In share capital, £1,500,000 [$7,299,750]; in first-mortgage debenture stock, £1,000,000 [$4,866,500], the share capital being divided into 800,000 preferred ordinary shares of £1 [$4.87] each and 700,000 deferred ordinary shares of £10 [$48.66] each. The actual issue was £750,000 [$3,649,875] 4 per cent first-mortgage debenture stock, 650,000 preferred ordinary shares, and 531,000 deferred ordinary shares; total, £1,931,800 [$9,401,104]. The prospectus estimated the net profits per annum accruing from the 38 businesses at £112,065 [$545,364]. The net profits as earned for 1900 were £74,573 [$362,909]; 1901, £16,812 [$78,267], and 1902, £43,318 [$210,783]. The year 1901 showed a debit balance, after paying all charges, of £16,813 [$78,272], which last year was increased to £18,074 [$87,957]. Since the formation of the wool-combers' trust the managers have only paid debenture interest and 5 per cent on the preference shares. Last November the bank refused to increase their overdraft, payment was stopped, and since that time the syndicate has been in the hands of two gentlemen—one representing the bank and the other debenture-stock holders—pending a scheme of reconstruction. It is impossible to say now whether such a scheme will be approved by all the venders, five still refusing to admit such a course of action. The outstanding venders maintain that there is little to choose between liquidation and reconstruction, several preferring the former process, because this would release them from continuing their services with the Wool Combers' Association and give them an opportunity of starting in business again on their own account.

CHARGES FOR WOOL COMBING.

At the annual meeting of the Wool Combers' Association the chairman laid special emphasis on the increased charges which all wool combers in Bradford had been compelled to make in view of the increased cost of working plants; fuel, soaps, oils, and other materials having all gone up in value. The following table shows to-day's cost of combing the various classes of wool in Bradford:

Merino wools.

	Cents.
Wool tearing 7 and upward of top to 1 of noil	4
Wool tearing 5 and under 7 of top to 1 of noil	5
Wool tearing 3 and under 5 of top to 1 of noil	5
Wool tearing 3½ and under 3 of top to 1 of noil	5½
Wool tearing under 2½ of top to 1 of noil	6

Burring and regilling, each half a cent extra.

Crossbred wools.

	Cents.
56s crossbreds	3½
50s crossbreds	3
50s crossbreds under 7 of top to 1 of noil	3½
40s to 46s carding	2¾
40s to 46s carding under 8 of top to 1 of noil	3

Burring and regilling, each a quarter of a cent extra.
No carding to be done under 2¾ cents.
All qualities above 56s crossbreds to come in under the merino tariff.

Iceland.

	Cents.
Wool tearing over 8 of top to 1 of noil	3
Wool tearing under 8 of top to 1 of noil	3¼

As showing how times have changed in the wool-combing industry of Bradford, and how charges have fallen in this branch of trade, the following table was published, under the names of 16 of the first combers in Bradford, on January 9, 1895. The difference between to-day's prices and those of eight years ago is worthy of note. The charges below have reference to merino wools only:

	Cents.
For wool tearing under 2 to 1	8
For wool tearing over 2 and under 2½ to 1	7¼
For wool tearing over 2½ and under 3 to 1	7
For wool tearing over 3 and under 4 to 1	6
For wool tearing over 4 and under 5 to 1	5
For wool tearing over 5 and under 6 to 1	5
For wool tearing over 6 and under 7 to 1	4
For wool tearing 7 to 1	4

Wool-combing invoices are always net, no discount being allowed off wool-combing accounts.

WOOL COMBERS' WAGES.

The wool-combing industry of Bradford being of such large dimensions, it naturally follows that a large staff is employed. Full time is spoken of in this industry when factories work day and night, two shifts of men being then employed. At present work is carried on by day only, and, although Bradford has enjoyed a good year's trade, the wool combers have been somewhat slack, owing to the shortage of the Australian wool clip. I have obtained a list of wages paid the help in the wool-combing industry, my informant (an acknowledged expert

in connection with labor matters) stating that "it is by no means an average one, but obtains in one of the best-paying firms of the city."

Table of weekly wages.

Description.	Night work.	Day work.
Warehouse (men only):		
Bowl minders—		
3 bowls	$5.28	$4.80
Feeders	4.32	3.36
Strippers and grinders (men, each of whom has to attend 12 cards and 2 grinders), jobbers, for 11 botany cards or 6 English	5.28	4.80
Card feeders, by hoppers and hand, for 6 cards:		
Men	4.32	....
Women	....	2.88
Back-end minders, by balling head or coiler cans:		
For 6 English cards—		
Men	4.56	....
Women	....	2.88
For 11 botany—		
Men	4.32	....
Women	....	2.88
Burr takers-out (men), for 11 cards	4.32	3.36
Shoddy willevers (men)	....	4.32
Wool runners (men), for 11 cards	5.28	4.32
Backwash minders (men), for 1 backward and strong box	5.28	2.88
Finishing box minders:		
Men—		
English (for 4 boxes)	4.56	....
Medium (for 2 boxes)	4.32	....
Women—		
English (for 4 boxes)	....	2.88
Medium (for 2 boxes)	....	2.88
Comb minders:		
Men—		
English (for 2 combs)	5.52	....
Medium	5.28	....
Botany	4.80	....
Women—		
English (for 2 combs)	....	3.36
Medium	....	2.00
Botany	....	2.00
Strong gill-box minders:		
Men—		
Botany (for 2 boxes)	4.32	....
Medium	4.32	....
English (for 4 boxes)	4.56	....
Women—		
English	....	2.88
Botany	....	2.88
Making-up box minders:		
Men	4.32	....
Women	....	2.88
Jobbers (men):		
English	6.24	4.80
Botany	5.76	4.80
One man taking noils and cans out of 4 combs	....	4.80

The above figures refer to wages earned when a worker had done a full week's work, that is, fifty-five and one-half hours on the day turn and from sixty-three to sixty-four hours on the night turn.—(*Erastus S. Day, consul at Bradford, England, in Consular Report for January 29, 1903.*)

Sterilization of meat in Belgium.—The sterilization of meat in Belgium was first practiced at St. Nicolas, a town in Flanders, and is yearly gaining in importance. The object of this innovation is to return to the trade, under the form of a wholesome product, meat which otherwise would be unfit for consumption.

During the year 1902 the total quantity of meat sterilized in the kingdom amounted to 152,023 kilograms (334,451 pounds), distributed among the principal cities, as follows:

City.	Quantity.	United States equivalent.
	Kilograms.	*Pounds.*
Antwerp	36,699	80,738
Ghent	35,968	79,130
Herenthals	12,936	28,459
Verviers	6,643	14,615
Neufchateau	800	1,760

Sterilized meat sells at prices ranging from 25 to 80 centimes (4.8 to 15.4 cents) per kilogram (2.2 pounds), according to locality, while the sterilized juice sells for from 15 to 30 centimes (2.8 to 5.7 cents) per quart. The meat is also converted into extract, the cost price of which, not including labor, is 2.50 francs (48.2 cents) per quart.—(*Geo. W. Roosevelt, consul at Brussels, in Consular Report for February 28, 1903.*)

How shoddy is made.—The rags are first treated to an acid bath in a weak solution of vitriol and water, and then the liquid is allowed to drain back into the tank. The purpose of this bath is to destroy the vegetable fibers in the rags so that they may be removed easily by processes which follow. They are later placed in a close room heated to a temperature ranging from 210° to 217°, a heat sufficient to kill all germs with which the most filthy might be affected. After that they are given a bath of cold water and thoroughly cleansed in a cylinder in which the mass of rags is kept in constant motion. This is continued until the water which flows from the rags is as clear as that which is at intervals poured upon them. They are then dried and put through the various processes of the mill and the product comes from the machinery clean and pure—purer, in fact, than many of the wools which are imported, I shall say, from tropical countries. After such processes and such treatment it is not deleterious to health, the acid bath and the intense heat destroying all possible contagion. The

French call it the Renaissance of wool—the new birth of wool—for one of its peculiarities is indestructibility. It is possible to use it many times in manufacturing. Though the frequent use may impair its quality, it still retains sufficient strength, weight, and warmth to be useful in producing many warm, attractive, and cheap fabrics.—(*J. B. McPherson, Secretary of the National Association of Wool Manufacturers.*)

Injurious effect of German meat-inspection law.—Vice-Consul General Murphy sends the following translation from the Frankfurter Zeitung of June 22, 1903:

Pork prices are now 20 per cent less than a year ago, and it is possible that as the summer advances there will be a further fall. How is it possible that in spite of the complete closing of the frontiers, in spite of the meat-inspection law, which renders importation difficult, prices have not risen? If the frontiers were opened to-day for the admission of foreign pork the Agrarians would cry out that this importation was the cause of the low prices; but now we have the proof that this is not so. The abnormally high prices of the past two years have lessened the consumption, and some time will be required to again increase the consumption of pork by means of temptingly cheap prices. Through the chicanery of the provisions of the meat-inspection law, through the chicanery of the measures enforced against foreign meat on our German imperial frontiers (resorted to under the pretense of sanitary protection), other countries have been led to adopt similar measures against German products. Thus, for instance, after July 1 German meat products, be they Westphalian hams, Thuringian sausage, or Frankfort wuerstchen, will no longer be admitted into the United States, or only after undergoing the same troublesome and expensive inspection as that now enforced in Germany. The great sausage factories in Westphalia, which for twenty-five years have been exporting hundreds of thousands of sausages to the United States, are exposed to ruin, and the exportation of canned Frankfort sausages is likewise seriously threatened. Thus is closed a safety valve which was always before open whenever German pork prices fell to a low level. At such times much more than usual was formerly manufactured for foreign markets. Now this resource is lost, and the same people who thought that they were playing their greatest trump in the enactment of the meat-inspection law, believing that it would hinder importation from abroad and thus keep the price of hogs at a high level in Germany, now find themselves deprived of the anticipated fruit of their policy.

Decline in Germany's meat imports.—During the months of April and May of the years 1903 and 1902 the imports of meat and meat products into Germany were as follows (sausages and canned meat came under the inhibitory regulations on October 1, 1902), the amounts being given in metric tons of 2,204.6 pounds:

Article.	1903.	1902.	Decrease.
	Tons.	*Tons.*	*Tons.*
Fresh beef	1,192	2,151	959
Pickled pork	474	1,365	891
Fresh pork	936	1,989	1,053
Hams and bacon	854	2,876	2,022
Lard and other fats for seasoning	10,109	17,142	7,033
Total	13,565	25,523	11,958

The butchers in their annual convention lately held at Potsdam adopted a resolution to petition the Government to ameliorate the order against allowing live stock to come in from foreign countries and to reduce the customs duties on imported cattle and hogs.—(*Simon W. Hanauer, deputy consul-general, Frankfort, July 5, 1903.*)

New meat-inspection law in Germany.—The new meat-inspection law went into effect in Germany on April 1, 1903. What trouble and expenditure it must bring to the importer and how much it is sure to increase the cost of living to the consumer may be seen from a case which occurred recently at Bremen.

A local firm had imported 20 barrels of pork livers from New York, which were examined at Bremerhaven in accordance with the new rules and regulations. At the end of the examination the following bill was presented and paid to cover the expenses:

	Amount.	United States equivalent.
	Marks.	*Dollars.*
To general fees for examination	75.65	18.00
To chemical examination	60.50	14.40
To examination for trichinæ, 50 pfennigs for each 587 livers	293.50	69.85
Total	429.65	102.25

In addition the firm has to pay a duty on said livers as follows: Gross weight, 3,596 kilograms (7,929 pounds), less 16 per cent tare; net weight, 3,020 kilograms (6,659 pounds), at 17 marks ($4.04) per 100 kilograms (220 pounds), or 513.50 marks ($122.21).

Hence the cost for bringing these 20 barrels of American hog product into this country amounted to 943.15 marks ($224.46), or more than 30 per cent of the original cost of the goods, which was only 3,000 marks ($714).

This case gained considerable notoriety and was brought to the attention of the proper department at Berlin. It was hoped that the authorities there would order a reduction of the charges for entering these livers, which, as a precautionary measure, had been boiled before shipment, so as to remove any objection. However, the Secretary of the Interior decided a few days ago that, inasmuch as these livers weighed less than 4 kilograms (8.82 pounds), section 12 of the second chapter of the new law absolutely prohibited their importation into Germany.—(*Henry W. Diederich, consul, Bremen, June 5, 1903.*)

Cost of meat in Germany.—United States Consul Muench, at Plauen, Germany, reported (Consular Report, February, 1904) that there is no decrease in the high cost of living in Germany to which he had

referred a year before. He says that among the working people meat has become a luxury. The ruling prices per pound at Plauen for 1902 (in quantities of not less than 110 pounds) are shown in the following table:

Wholesale prices of meat at Plauen in 1902.

Description.	First quality.	Second quality.	Third quality.	Fourth quality.
	Cents.	*Cents.*	*Cents.*	*Cents.*
Steers	15.32	14.68	13.92	....
Bullocks	14.67	14.04	13.33	....
Cows and heifers	14.61	14.04	13.33	12.59
Veal, live	10.73	10.13	9.68	....
Mutton, live	7.66	7.28	6.94	....
Pork	15.73	15.25	14.63	....

While a very thorough system of meat inspection at the public slaughterhouses, or abattoirs, assures the consumers of the complete healthfulness of the meat, it adds to the cost, which to the consumer in the city of Plauen is from 25 to 40 cents at retail. The consumption of meat in this comparatively wealthy district amounted in 1902 to 68.54 pounds per capita.

The object of German meat restrictions.—The following is from Hon. Simon W. Hanauer, deputy consul-general at Frankfort, Germany, and is published in Consular Report for January, 1904:

The report of the chamber of commerce for the State and city of Hamburg says on the subject of restrictions on the importations of meats that they are Agrarian measures, instituted for the purpose of forcing high prices for domestic meat, and are not justifiable on sanitary grounds. It mentions particularly "corned beef," against which nothing can be alleged as being hurtful to consumers, and it quotes the opinions of experts to show that the small amount of boracic acid used for the preserving of the meat is not injurious and is actually indispensable. The chamber instituted inquiries among the Hamburg shipowners, who said that since foreign canned meats have been used on their vessels the health of the crews has been much improved, but after trial it was found that the canned meat put up in Germany is inferior to the foreign article. The report further expresses the hope that the Federal Government will soon realize the fact that by keeping out cheap foreign meat a serious injury is done to the working classes of Germany, and that such injury must create intense feeling and strengthen the Social-Democratic party.

Slaughterhouse prices in Germany.—Statistics on slaughterhouse prices which were recently made public show that there have been some changes in the meat supply of the Empire. The scarcity of hogs, which became very pronounced from 1900 to the end of 1902, is reported to have been somewhat relieved. On the other hand, the supply of the best quality of cattle, calves, and sheep has not been adequate to meet the demands of the market. The slaughterhouse statistics show that both the number and quality of cattle driven to the market leave much to be desired. As a result of this scarcity the

prices for beef, veal, and mutton have been considerably advanced during the last year.

The following table is a comparison of the average wholesale prices paid for meats during the third quarter of 1901 and of 1903 at the slaughterhouse at Chemnitz. The prices are per 110 pounds of dressed beef and undressed veal and mutton:

Description.	Price.		Description.	Price.	
	1901.	1903.		1901.	1903.
Steers:			Bulls:		
First quality (full fed, up to 6 years)	$15.19	$16.69	Full fed	$13.87	$15.66
Second quality (young, not full fed, or older, full fed)	14.50	15.72	Medium fed	13.18	15.09
Third quality (medium-fed young, well-fed old)	13.50	14.72	Poorly fed	12.25	14.22
Fourth quality (poorly fed, any age)	12.65	13.51	Calves:		
Heifers and cows:			Full fed	9.52	10.97
Heifers, first quality	15.10	16.47	Medium fed	8.87	10.35
Cows, first quality	14.76	16.00	Poorly fed	8.06	9.36
Cows and calves—			Sheep:		
Third quality	12.27	13.84	Lambs, young, full fed	7.96	8.70
Fourth quality	10.21	12.26	Wethers, older, full fed	6.92	8.16
			Wethers and sheep, medium fed	6.22	7.35

The following statement, by J. F. Monaghan, consul, Chemnitz, Germany, October 29, 1903, shows the increases for every 110 pounds of dressed or undressed meat, as indicated above, in 1903 as compared with 1901, viz:

Steers, first quality	$1.30
Heifers	1.37
Cows	1.24
Bulls	1.59
Calves	1.45
Sheep	1.14

The prices for beef and veal are at present continuing in their upward tendency, as is shown by the fact that for the first half of October the average prices were considerably higher than recorded above, viz:

Steers	$17.26
Heifers	17.20
Cows	16.72
Bulls	16.01
Calves	12.40

Increased French duties on cattle and meats.—The bill increasing the duty on cattle, hogs, and other animals and on dried and salted meats, which was passed during the last days of the recent Parliament, was signed by the President of the French Republic on July 21 last,

promulgated in the Journal Officiel of August 11, 1903, and is now in force.

Under the old customs law there was but one tariff for all the animals and products mentioned in the new act, with the exception of salted beef, while under the present régime not only have maximum and minimum tariffs been established, but duties have been greatly increased. In the following table are given the details of the new customs law, together with a comparison between the old and the new duties:

Comparison between old and new duties on cattle, meats, etc.

Article.	New tariff law.				Old tariff law.	
	Maximum.	Increase.	Minimum.	Increase.	Maximum.	Minimum.
Steers................per 220.46 pounds live weight..	$5.79	$3.86	$3.86	$1.93	$1.93	$1.93
Cows ....do....	5.79	3.86	3.86	1.93	1.93	1.93
Bulls ....do....	5.79	3.86	3.86	1.93	1.93	1.93
Young bulls and heifers............do....	5.79	3.86	3.86	1.93	1.93	1.93
Calves ....do....	7.72	5.40	4.825	2.505	2.32	2.32
Sheep ....do....	7.72	4.73	4.825	1.835	2.99	2.99
Lambs, weighing 22 pounds and under...per head..	.772	.483	.434	.145	.289	.289
Goats ....do....	.868	.483	.579	.193	.386	.386
Kids ....do....	.386	.193	.289	.096	.193	.193
Hogs................per 220.46 pounds live weight..	4.825	3.285	2.895	1.355	1.54	1.54
Sucking pigs of 33 pounds and under.....per head..	.772	.483	.434	.145	.289	.289
Fresh meats:						
Mutton..................per 220.46 pounds..	9.65	3.48	6.755	.585	6.17	6.17
Pork ....do....	7.72	5.40	4.825	2.505	2.32	2.32
Beef ....do....	9.65	4.825	6.755	1.93	4.825	4.825
Salted meats:						
Pork, ham, bacon, etc ....do....	9.65	4.825	5.79	.965	4.825	4.825
Beef and other ....do....	9.65	3.86	5.79	.58	5.79	5.21

After the passage of the law the Chamber of Commerce of Havre, through its president, asked the minister of commerce if cattle and meats—especially salted meats of American origin—could be allowed to enter Paris on payment of the minimum tariff, the same as lard and its compounds and manufactured meat (charcuterie). The latter products enjoy the benefits of the minimum tariff, in accordance with the reciprocity agreement which was entered into by France and the United States May 30, 1898.

The minister, in his reply, said that although by the terms of the law of April 5, 1898, the French Government, by decree, was able to apply the minimum tariff to lard and manufactured meat coming from the United States there was no provision in the new law by which the minimum tariff could be applied to any of the products enumerated in that measure.

Hereafter cattle, sheep, goats, hogs, etc., and fresh and salted meats produced from the same will be subjected to the maximum tariff if imported into France direct from the United States, or if imported

indirect through a European country there will be an additional tax of 3.60 francs (69.5 cents) per 100 kilograms (220.46 pounds).

The American cattle and fresh-meat trade with France is practically nil, due, in great part, to the rigid sanitary measures prescribed by the French Government for the inspection of cattle and fresh meats imported into France. The trade also in American salted, pickled, and cured meats with France has been progressively declining for a number of years past on account of the heavy duties imposed on these products by the French customs law and the high prices which have been prevailing in the United States. The falling off in the salted-meat trade is shown in the following table, in which are given the weights and values of the exports of salted beef and hog products from the United States for the past three years:

Exports of beef and hog products from the United States to France during the years 1900, 1901, and 1902.

Description.	1900.		1901.		1902.	
	Weight.	Value.	Weight.	Value.	Weight.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
Canned beef	1,175,776	$118,842	674,588	$67,443	592,000	$60,015
Salted, pickled, and cured beef	559,100	31,913	148,890	7,697	101,000	6,590
Bacon	7,464,961	494,066	1,960,196	155,969	282,884	27,236
Ham	1,754,585	174,118	320,856	31,454	138,592	14,676
Pork, fresh and salted	111,725	6,771	91,800	7,295	46,000	4,621

The prices of American salted meats having fallen during the past three or four months some business has been done in these products in the French markets; but the new law will tend to greatly restrict the trade, if not to do away with it altogether.—(*A. M. Thackara, consul at Havre, France, August 12, 1903.*)

Horse meat in Paris.—It is stated that at the Villejuit slaughter-houses 23,000 horses are killed annually and at Pantin 7,500, making a total of 30,500. Of this number 10,500 are consumed in the environs of Paris, leaving a consumption of 19,500 in the city itself. The average weight of each horse is said to be 250 kilograms (551.15 pounds). One-third of this, however, is composed of bone and sinew, sold as waste at 4 francs (77.2 cents) per 200 kilograms (440.92 pounds). There remain, therefore, about 167 kilograms (368.17 pounds) of marketable meat to each horse, which would give a total consumption of 3,256,000 kilograms (7,178,177.6 pounds) annually.—(*Thornwell Haynes, consul at Rouen, France, May 13, 1903.*)

Meat statistics in Hawaii.—Statistics in the Second Annual Report of the Hawaiian Live Stock Breeders' Association show that during the year ended June 30, 1903, there were slaughtered by the Metro-

politan Meat Company, 6,895 cattle, 1,197 calves, and 10,181 sheep, having a total value of $357,810.84. During this time beef was imported to the value of $2,355.10, mutton to the value of $17,743, and pork worth $12,387.53, a total of $32,486.05.

Meat-canning factory in Veracruz.—The following has been received from Consul W. W. Canada, under date of February 16, 1903:

The government of Veracruz has authorized Mr. Alfred Bishop Mason to establish a canning and preserving factory within the limits of the State. The place selected for the erection of buildings for killing beef cattle, sheep, goats, and hogs, as also the refrigerating plant for the meats and fish, is the town of San Antonio Tenejapa, county of Orizaba. As this is the first establishment of the kind in the State, and also on account of the large capital invested, the concern will be free of all taxation; but in case the products sold are in fresh, salted, or refrigerated condition the regular license tax on the killing of cattle is to be collected. The construction of the plant is to be completed within two years. The State government agrees not to give similar privileges to any other like enterprise during the term of ten years.

Argentina's meat supply.—On March 24, 1903, the Bureau of Statistics published the terms of the Argentine-Uruguayan convention as to sanitary inspection of live stock, the completion of which was necessary to bring about a reopening of the British ports to Argentine stock. To that convention is due, perhaps, the recent increase in the meat production of Argentina, as shown by the following statistics taken from the South American Journal of August 29, 1903:

Extraordinary progress has been made in recent years in Argentina in the production and export of beef and mutton. Whereas in 1895 it was difficult to get 40,000 steers in all Argentina that were fit for the British market, the output since then has increased by 40,000 head per annum, and last year it totaled 250,000 head. Argentina's export of beef and mutton will continue to go up by leaps and bounds. It is not unreasonable to believe that by the end of the present decade Argentina will be able to export to the European market — which practically means the British market—no less than 10,000,000 hundredweight of beef and 5,000,000 hundredweight of mutton. The resources of Argentina are practically unlimited, and they have been immeasurably developed in recent years by the wholesale laying down of Argentine lands to alfalfa, a very nutritious leguminous crop, which enriches the land with nitrogen gathered from the atmosphere and is, through its deep-rooting habits, practically uninjured by drouth. There appears to be no reason to doubt that the exports of beef and mutton from Argentina will continue to steadily increase. Indeed, it seems clear enough that between Canada, on the one hand, as an exporter of wheat, and Argentina, on the other hand, as an exporter of meat, the British farmer will before long have to face a keener and more cutting competition than ever before.

Inspection of cattle in Argentina.—Minister Lord sends from Buenos Aires, February 4, 1903, clippings from a local journal containing the terms of the convention with Uruguay as to sanitary inspection of live stock, the completion of which was necessary to

bring about a reopening of the British ports to Argentine stock. The clipping reads:

The following is the substance of the decree issued yesterday by the minister of agriculture:

The preamble states that, in addition to the alterations made in the regulations of February 15, 1902, it is convenient to specify the prescriptions to which the foreign commerce in cattle must be submitted, that of oversea as well as of the oriental Republic of Uruguay, as regards relations with the latter.

Article 1.—Prohibits (*a*) the importation or landing of animals, animal remains, etc., from any nation where contagious or infectious disease in animals exists which may be dangerous to the national live stock; (*b*) the importation of animals proceeding from a nation whose laws and regulations and their application do not, in the opinion of the Executive, offer a sufficient guaranty against contagion; (*c*) the importation from abroad through any other port than Buenos Aires; (*d*) the importation of animals from a nation whose live stock may be imported into the Argentine Republic when those animals, though proceeding from a nation free from disease, may have originally come from a prohibited nation; (*e*)the importation of animals in a ship which had, within thirty days prior to their embarkation, loaded animals in a prohibited nation; (*f*) the importation of animals in a ship which after loading has been in contact with any kind of animals proceeding from a prohibited nation, or which has called at a port of any such nation; (*g*) the entry into an Argentine port of any ship which during the preceding sixty days shall have loaded animals of such a nation; (*h*) the importation of animals attacked by "garrapatas" (ticks).

Article 2.—Prohibits the exportation of animals attacked by contagious disease or suspected of being so, or bruised, and of those that have not undergone veterinary inspection in the estancia and at the port of embarkation, and have not been transported in disinfected vehicles; also exportation in a ship which has on board animals from prohibited nation, or has not been disinfected after having remained in or touched at, during the preceding sixty days, the port of a nation prohibited by reason of the cattle plague, or during thirty days, if prohibited on account of the existence of contagious peripneumonia, foot-and-mouth disease, or glanders; also the exportation of cattle attacked by garrapatas.

Article 3.—For the purpose of this decree the nations mentioned in the decrees of the 9th and 16th instant are declared to be prohibited, and the prohibition will continue until in the opinion of the Executive the animals of the respective nations can be imported without danger.

American pork no longer prohibited in Turkey.—On April 20, 1881, the Sublime Porte issued a decree prohibiting, "in consequence of the existence of trichinæ in the salt pork imported from America," importation of this meat into the Empire. A year later this measure of interdiction was extended to ham and lard from the same source. Minister Wallace observed in those days that in spite of the decree nearly nine-tenths of the salted meats consumed in Turkey would continue to be American under some foreign brand. While this prediction has proved correct to some extent, it is interesting to learn that the Turkish Government, in reply to representations made in April, 1900, by Mr. Griscom, chargé d'affaires, and in March, 1901, by Minister Leishman, has removed the prohibition against the importation of American pork products. Importations of this character must be accompanied by certificates from the sanitary authorities at the point of departure, authenticated by the Turkish consul, showing that the

article has been microscopically examined and found clean. On arrival in a Turkish port the shipment will be examined again and admitted if found perfectly sound; otherwise it will be returned. In my report on this subject to the Department of State under date of February 2, 1900, I stated that grocers here wanted American hams for this market. I would now recommend that exporters at home take advantage of the opening afforded. Correspondence should be addressed to Fadoul Ribeiz, George Komnos, or Naijib Letayf, of Beirut; American Exchange Company, Haifa; Meshaka & Nachman, Damascus; John Hakim, Tripoli.—(*G. Bie Ravndal, consul at Beirut, Syria, July 1, 1903.*)

Meat exports of New Zealand in 1902.—The New Zealand Trade Review publishes the following figures, covering the meat exports of 1902, and a comparison with 1901:

Description.	1902.		1901.	
	English money.	United States equivalent.	English money.	United States equivalent.
Beef:				
Fresh	£56	$273	£165	$803
Frozen	370,691	1,803,967	258,951	1,260,185
Salted	9,708	47,243	8,463	41,185
Lambs, frozen	898,534	4,372,715	781,831	3,804,781
Mutton, frozen	1,183,072	5,757,419	1,027,679	5,001,200
Sheep	109,030	530,594	48,410	235,587
Pork:				
Frozen	9,729	47,346	6,535	31,803
Salted	129	628	1,762	8,574
Poultry, frozen	8,101	39,424	419	2,039
Veal, frozen	1,682	8,185	173	842
Other meat	8,318	40,478	1,881	9,153
Rabbits, frozen	116,996	569,361	114,552	557,467
Hares, frozen	1,888	9,187	3,261	15,870
Prepared and preserved meat	123,633	601,660	87,706	426,821
Meat extracts	17,951	87,358	847	4,122
Total, including notions not named	2,859,518	13,915,838	2,342,635	11,399,632

Butter industry in the Argentine Republic.—During the years 1895–1899, inclusive, 9,027,027 pounds of butter were exported from the Argentine Republic, an average of 1,805,405 pounds per year. In 1900 the exports of butter amounted to 2,322,663 pounds, in 1901 they increased to 3,322,391 pounds, and in 1902 they reached a total of 9,240,000 pounds,[a] an increase of 170 per cent on the previous year and of 400 per cent on the average of the five years 1895–1899. For the first three months of the current year the returns show an exportation of 4,533,760 pounds[b] of butter, about half of the amount exported during the whole of 1902.

[a] Official figures, 4,125 tons. [b] Official figures, 2,024 tons.

The following table shows the amount of Argentine butter imported by various nations during the five years 1895–1899, and also for 1900 and 1901. Detailed figures for 1902 and the first three months of 1903 are not available.

Country importing.	1895–1899.	1900.	1901.
	Pounds.	*Pounds.*	*Pounds.*
Africa	4,986		
Germany	54,606		
Belgium	41,800		110
Bolivia	68		
Brazil	544,573	23,599	40,172
Chile	147		
Spain	11,774		220
France	5,962		
Italy	2,244		
United Kingdom	8,355,246	2,298,789	3,281,889
Uruguay	5,621	275	
Total	9,027,027	2,322,663	3,322,391

The price of butter at the creameries here may be estimated, allowing a good margin of profit to the dairyman, at about 16 cents in United States currency per pound.

At retail in this city the average price of butter per pound in December for the years 1899–1902 has been:

	Cents.
1899	$19\frac{1}{5}$
1900	$19\frac{3}{5}$
1901	20
1902	$18\frac{2}{5}$

From these figures and from a study of railroad rates for the transportation of butter it seems safe to fix the average price of Argentine butter f. o. b. at 18 cents per pound.

The following table shows the prices ruling in the London market during December in the years 1900–1902 (reduced approximately to United States currency per pound) for butter imported from various countries:

Imported from—	1900.	1901.	1902.
	Cents.	*Cents.*	*Cents.*
Holland	24 to 26	24 to $24\frac{2}{5}$	$22\frac{2}{3}$ to $22\frac{2}{5}$
France	$25\frac{1}{4}$ to $27\frac{1}{2}$	23 to $24\frac{4}{5}$	$22\frac{2}{3}$ to $25\frac{1}{4}$
Denmark	$26\frac{3}{5}$ to $28\frac{1}{8}$	24 to $25\frac{3}{4}$	$24\frac{2}{5}$ to $26\frac{1}{5}$
Russia	$17\frac{4}{9}$ to $21\frac{1}{3}$	$15\frac{1}{4}$ to 26	$17\frac{8}{9}$ to 23
Canada	$16\frac{5}{9}$ to $21\frac{4}{5}$	$16\frac{5}{9}$ to $22\frac{1}{4}$	$20\frac{1}{2}$ to 23
Australia	$15\frac{1}{4}$ to $24\frac{4}{5}$	$15\frac{1}{4}$ to 24	$20\frac{1}{2}$ to $24\frac{4}{5}$
Argentina	$16\frac{5}{9}$ to $24\frac{2}{5}$	$23\frac{4}{5}$ to 24	$23\frac{1}{2}$ to $24\frac{2}{5}$

From the foregoing it will be seen that Argentine butter has improved in price in the London market very rapidly in the last three years,

until it now stands second as regards demand, and that the average price—approximately 24 cents—leaves a high rate of profit to the Argentine exporter.

It is only natural, therefore, that the dairy industry should be increasing rapidly in importance here, and it should ultimately reach enormous proportions. By conservative estimates the average yield of milch cows is 4 quarts per day. Assuming that there will be two hundred and fifty milking days per year, each cow will give 1,000 quarts of milk annually. With improved machinery this milk will yield from 3.2 to 3.3 per cent butter, or, say, 65 pounds per year.

At this rate the amount of butter exported during 1902 (9,021,026 pounds) would represent the yield from 138,000 cows or thereabouts. Unfortunately, no statistics exist with regard to the home consumption of milk and butter; consequently no very accurate estimate can be made of the number of cows now in use for dairy purposes in the Argentine Republic. Assuming that there are 700,000—apparently a fair estimate—there remain about 8,000,000 cows which could be utilized for dairy purposes.

The average cost of a small creamery may be estimated as follows:

500 cows, at $25 each = $12,500 at 8 per cent per annum	$1,000
500 hectares of land, rented at $2.50	1,250
10 peons (laborers), at $16 per month	1,920
House, cart, horses, extra peons, etc	660
Unforeseen loss in animals, taxes, etc	770
Coal, oil, machinist, etc	440
Interest on machinery	130
Total	6,170

The yearly yield may be estimated as follows:

500 cows, at 4 quarts of milk per day for 250 days=500,000 quarts, yielding, at 3.15 per cent, approximately 31,500 pounds of butter, at minimum price of 16 cents per pound	$5,040
500 calves, less 20 per cent = 400, at $6.60	2,640
Total	7,680

This would leave a yearly profit of, say, 24 per cent on the capital invested. Allowing for some exaggeration in the estimates of yield, one can safely put the profit at 20 per cent.

Much is being done toward improving the breed of cattle in this country, and the milk-producing stock will doubtless soon be greatly bettered. The Durham breed is the principal base for the crossing of Argentine cattle, and will in a few years predominate on the estancias, or estates. The splendid results obtained from the Durham breed for dairy purposes are well illustrated on the estancias of Messrs. Santamarina, at Tandil. In a little less than six months 5,000 mixed or mestiza Durham cows (natives crossed with Durhams) have been tamed. From these 3,750 good milch cows have been obtained, each giving an average of over 4 quarts a day. In a short time all 5,000

will be giving the same results and the dairy will produce 330,000 pounds of butter per year.

Some of the leading estancieros (farmers) have gone in for crossing the Durham and Flemish breeds and have obtained excellent results.

The principal dairies in the country are:

The Granja Blanca, belonging to Mr. E. Fynn, established some twelve years. It has two establishments besides the factory in Buenos Ayres. The first, at Las Heras, had on December 31, 1902, 2,455 milch cows, and on the Escobar farm there were 2,492. The returns from the Las Heras farm for 1902 were:

Breed.	Yield per cow.		Average of butter.
	Per year.	Per day.	
	Quarts.	*Quarts.*	*Per cent.*
Flemish	1,522	4.1	2.9
Dutch	1,305	3.5	3.2
Durham	1,632	4.4	3.2

This establishment turns out the following products: Pasteurized milk, maternized milk for rearing children, sterilized milk, in bottles and tins, for travelers and invalids, concentrated and condensed milk, kefir, sweet milk, butter, soap, casein, and milk liqueur.

The Martona, at Canueles, is another establishment which ranks high. It belongs to Mr. Vincente L. Casares and, like the Granja Blanca, has shops all over Buenos Aires.

The Company La Union Argentina, at Buenos Aires, makes butter from milk and cream sent to it from all parts of the Republic. It has lately purchased one of the largest Radiator separators in the world, capable of handling from 2,500 to 3,500 quarts of milk per hour.

La Marina owns a farm at Las Palmas with 9 dairies and 1,050 Durham cows, and there are 1,600 more when any of the others get dry. It also possesses a creamery in Zapiola, with a cheese factory; about 300 cows are milked there.

A group of estancieros sends milk to the Progreso and Tandilera dairies. The factories make the butter for 1.2 cents per pound, and, in case of export, they guarantee the estancieros a minimum of $19.54 per 100 pounds. The Progreso turns out 2¾ tons per day and the Tandilera 2½ tons.

The Santamarina creamery, in Tandil, has 3,000 cows, and will shortly work 5,000; there will be 24 dairies spread over 24½ leagues.

The dairy industry is now spreading from the Province of Buenos Ayres to other parts of the Republic; Cordoba, Santa Fe, and Entre Rios are all going in for the business. Large orders are being placed with importers of dairy machinery.—(*Edward Winslow Ames, Chargé d'Affaires ad interim, Buenos Aires, May 18, 1903.*)

Butter-making machinery in Canada.—Quebec and Ontario are the best butter-producing Provinces in the Dominion of Canada. One can hardly travel in any direction without seeing a creamery or a cheese factory. Small farms are scarce; on the other hand the acreage to a farm is generally 200 or more, most of which is given up to pasturing and the raising of hay and grain. The average number of cattle to a farm is 30 or more. Since the establishment of creameries at almost every hamlet or village in these provinces the making of butter by hand has been done away with. I find that separators from the United States can compete with those of Canadian make, and as separators are on the free list I am surprised that our manufacturers have not taken advantage of this, as well as of the excellent market, to extend their trade in these Provinces. In Canada I am convinced there is a splendid field for our people to operate in. The Canadians, as a rule, are anxious to try our machinery, which is superior to their own, as well as cheaper in price, and I would suggest that our manufacturers send their salesmen to these Provinces to work up this trade.—(*Felix S. S. Johnson, Commercial Agent, Stanbridge, Canada, September 1, 1903.*)

Dairy products of Manitoba in 1903.—Bulletin No. 69, issued by the Department of Agriculture and Immigration of Manitoba, gives the dairy products of that Province for 1903 as follows:

Butter marketed by farmers	$429,445.00
Creamery butter	277,901.98
Cheese (factory)	151,362.28
Total	858,709.26

The quantity of butter was 4,271,703 pounds; of cheese, 1,382,304 pounds.

American and Canadian cheese in England.—The importations of American cheese continue to decrease. Canada has more than ever become the principal source of supply of cheese for the English market, and on the average the quality is considered better than that put up in the United States, and at present the price has been rather lower.—(*James Boyle, consul, Liverpool, England, October, 1903.*)

Purification of milk by ozonization.—An apparatus in use in Germany for the purification of milk by ozonization is so constructed that the milk contained in a vessel flows thence in a thin stream into another vessel, placed below. The wires and carbon points of a strong electric battery are so arranged that the light arc passes through the stream or near it. The ozone which is thereby engendered from the oxygen of the air is said to be sufficient to kill all microorganisms contained in the milk.—(*Richard Guenther, consul-general, Frankfort, Germany, October, 1903.*)

Exports of Russian butter and eggs.—The exportation of butter and eggs from Russia is assuming large proportions. The regular steamship service lately established between Riga and London for the transportation of butter and eggs to England could not carry all the consignments and an extra steamship of large tonnage had to be added thereto. Even then about 30 carloads of butter could not be shipped as promptly as desired. Russian butter is even shipped from Siberia to Denmark. Some time ago frauds were discovered in this trade, some of the kegs coming from Tomsk, Siberia, being filled with bricks, sand, and hay. The Russian minister of finance has instituted an investigation in order to punish the perpetrators. To prevent a recurrence of such frauds the minister has directed safeguards to be adopted at the place of shipment and while the goods are in transit.—(*Simon W. Hanauer, deputy consul-general, Frankfort, Germany, August 31, 1903.*)

Butter and egg production of Europe.—Within the last ten years Russia has more than doubled its butter production. The Siberian Provinces, especially, have within a few years largely developed their butter industry, and it is stated that Siberia at present contains 608 dairies. The development of this industry has been greatly aided by the facilities furnished by the Government for the carriage of butter on the railroads and through special steamship service to England. The Government also runs special cars for the transportation of eggs to the seaports for shipment abroad.

Denmark, a large producer and exporter of butter and cheese, imports considerable quantities of cheap butter from Russia.

A Danish company has lately been organized, with a cash capital of 2,000,000 crowns ($536,000), for the purpose of exploiting Siberian dairy industries. It has already established branches in 30 districts of that country.

A German journal publishes the following statistics showing the number of cows in the principal dairying countries of Europe and the annual production of butter and cheese:

Number of cows and annual production of butter and cheese.

Country.	Cows.	Annual production of butter and cheese.
	Number.	*Metric tons.*
Russia	10,000,000	350,000
Germany	8,950,000	300,000
Austria	6,000,000	170,000
France	5,000,000	200,000
Italy	2,400,000	145,000
Belgium	800,000	60,000
Switzerland	800,000	70,000
Denmark	1,050,000	60,000
Holland	900,000	120,000

Italy's production of butter has trebled within the last decade.—(*Simon W. Hanauer, deputy consul-general at Frankfort, Germany, September, 1903.*)

Condensed eggs in South Africa.—Hon. Richard Guenther, U. S. consul-general at Frankfort, Germany, states in Consular Report for February, 1904, that "South Africa is a good market for condensed eggs, as fresh eggs are from 3s. 6d. to 7s. 6d. (85 cents to $1.82) per dozen. Condensed eggs are prepared from ordinary eggs by depriving them of their superfluous water and adding sugar. When being prepared for use, some water is added and the mixture quickly beaten; it can hardly be distinguished from fresh eggs. These condensed eggs are put up for the South African market in hermetically closed boxes, each containing from one pound to several pounds. A one-pound box contains about fifteen eggs."

Poultry marketed in Manitoba in 1903.—Bulletin No. 69, issued by the department of agriculture and immigration of Manitoba, gives the following report of the numbers of the different kinds of poultry marketed during the year 1903:

District.	Turkeys.	Geese.	Chickens.
Northwestern	12,090	10,660	47,450
Southwestern	19,536	9,176	114,700
North central	17,000	6,390	63,000
South central	23,100	10,500	44,550
Eastern	17,000	10,530	118,350
Total for Province	88,726	47,256	388,050

Egg-laying contest.—There has been concluded at the Butts poultry farm, Ashover, Chesterfield, Ireland, the great annual laying competition of the Utility Poultry Club. The season commenced October 12, 1903, and finished on January 1, 1904. Each pen contained four 1903 pullets, while the total egg yields and points for the season were as follows:

Breed.	Eggs.	Points.	Breed.	Eggs.	Points.
White Wyandottes	243	474	White Wyandottes	130	260
Do	218	435	Do	127	252
Buff Orpingtons	213	411	Buff Orpingtons	125	248
Buff Rocks	181	360	Do	118	236
Black Orpingtons	171	341	Do	117	234
Buff Orpingtons	170	337	White Wyandottes	111	219
Do	168	334	Anconas	104	207
White Wyandottes	169	333	White Wyandottes	106	207
Do	165	320	White Leghorns	101	201
Lincolnshire Buffs	157	314	Do	97	193
White Leghorns	151	296	Gold Wyandottes	102	193
Buff Orpingtons	147	293	Faverolles	96	191
Buff Plymouth Rocks	148	290	Silver Wyandottes	67	128
Buff Orpingtons	144	287	Partridge Wyandottes	38	75
Do	148	285	Black Minorcas	28	56

Two points are given for every egg over 1¾ ounces, and one point for every egg weighing 1¾ ounces or less.

The biggest incubator.—The largest incubator in existence has just been installed at the poultry plant of a large firm in Niagara County, N. Y. In length this incubator is 51 feet and its width is 4 feet 4 inches. It is made of wood and stands on legs about 3 feet above the floor of a basement, under a grain elevator. It has 50 compartments, each 24 inches square. In each compartment there are two trays, each capable of holding 75 eggs, which makes the total egg capacity of this single machine no less than 7,500.

The egg trays are set on double frames made of ⅞-inch stuff, and these frames are hinged by galvanized-iron arms or hinges. This feature is called the adjuster. In the bottom of each compartment, under each tray adjuster, there is a series of small holes, and on the bottom of each adjuster there is a steel pin that fits in the holes. As the pin is advanced toward the front in the holes the adjuster frame and egg tray resting thereon is lowered, until finally it settles on the bottom of the compartment. When the machine is started the temperature in the compartments is about 103°. As the hatch advances and the chicks develop the animal heat of the eggs is added to the various compartments, and this develops more heat in each of them. In compartments where the eggs are very fertile more heat develops from the egg life than in compartments where the eggs are less fertile, and the heat of each individual compartment is told by the temperature readings of the thermometer therein. Six days after the start the trays receive their first drop, and future drops are regulated by the temperature readings. Thus each compartment requires but a moment's attention, and for all it is a part of a great machine, its treatment is wholly regulated by the existing conditions.

An even temperature is maintained in the machine by a hot-water jacket heater at one end. This heater is made after the Hall patent. It stands about 3 feet high, and has triangular 14-inch grates. An expansion tank, 10 by 18 inches, made of galvanized iron, stands over the heater a little to one side. This tank is oil filled, and in it a float is operated. The principle of action is that as the furnace heat increases the water in the pipes of the jacket expands, causing the float in the oil-filled tank above to rise. This action closes a throttle attached to the float arm, and the draft of the heater is closed off, while at the same time another brass lever opens the cold-air draft of the heater. This double action makes it impossible to overheat the eggs in the machine, and it is surprising how sensitive the regulating device is Over the tops of the compartments sixteen 1¼-inch pipes are run for heating purposes. These run the entire length of the machine and are connected at the ends by headers. The doors of the compartments

are held closed by buttons. Each door has a double-glazed front, 7 by 20 inches in size, through which the eggs are visible. It should be remembered that the heat of the pipes always remains the same.

Mr. Hall built his first incubator twenty-eight years ago. Like many others he became fascinated with the poultry business. He was progressive, and soon reached a point where he found it too expensive to keep buying smaller machines. In the course of time he thought out and developed the plan of this wonderful machine, which gives promise of revolutionizing the poultry industry. Just think of what it can do! This one was installed by the firm to supplant about 40 incubators of various sizes and capacities. These 40 incubators were operated by oil lamps, and each lamp required careful trimming every morning. This work was not left to the attention of their employees, and so two of the firm devoted a half of every day to it. During the main hatching season their oil bill was about $150. This huge incubator does away with this oil bill, and requires but a few minutes' attention to the fire morning and evening, the regulator looking after the temperature, so that both time and money are saved.

While hatching may go on all the year round, let us say that the hatching season begins March 1 and ends August 1, covering a period of one hundred and fifty days. It requires twenty-one days to hatch chicks, so this great incubator could be filled at least seven times, which would require 52,500 eggs. Not all eggs placed in an incubator hatch, but should 50 per cent of the number given come out it would give 26,250 chicks, while a hatch of 75 per cent would mean 39,375 chicks, a pretty good season's business. Giving each hen 15 eggs it would require 3,500 hens to set the 52,500 egg capacity of this incubator, and the percentage of chicks hatched would be governed by similar uncertainties.

While man has thus succeeded in accomplishing with one machine what thousands of hens might do, he has not succeeded in becoming a rival of the hen in the actual work of producing eggs. Probably the hen will ever remain in charge of this department, but it is evident that the installation of such mammoth incubators must of necessity create a demand for eggs, possibly to the detriment of the housekeeper, until their chicken product gets down to the egg-laying business. Eggs that hatch must be fresh. At this writing fresh eggs are worth 40 cents a dozen, so that it would cost over $1,800 to fill the machine with eggs at the market price. Eggs for hatching, eggs from alleged fancy stock, are rated at $5 per setting of 15 eggs, and to fill this mammoth machine with that class of eggs would require an expenditure of $17,500.—(*Orrin E. Dunlap, in the Country Gentleman.*)

Introduction of musk oxen into Norway.—The Department of State has transmitted to this Department the information concerning the introduction of musk oxen into Norway which is contained in the following dispatch from Hon. Henry Bordewich, consul-general at Christiania, Norway:

One of the whalers belonging to the firm of Magnus K. Giaever, of Christiania and Tromsoe, brought with it from an expedition in 1903 five live musk oxen—four females and one male. The animals had been caught on the east coast of Greenland, and were supposed to be from four to five months old at the time. They were then from 3 to 3½ feet in height. They were placed on an island called Skaaroe, not far from Tromsoe, in Finmarken. The animals were not permitted to roam at large, but were given the run of a large inclosure and provided with a shed, where they might find shelter in bad weather. A keeper attended them; they were kindly treated, fed much like domestic animals, and they appeared to thrive well, and soon became very docile.

Of late there has been sickness among them, however, and one has died. I inclose two newspaper articles on the subject, with translations. The writer of one of these articles believes the climate in northern Norway to be unsuited for them, while the owner, in the other article, gives as his opinion that the experiment will prove successful, and that the cause of the disease is to be laid solely to the limited space of the inclosure and consequent lack of exercise for the animals.

There must be a wide difference between the climate of Greenland and that of the coast districts of Finmarken. The climate in the latter place is influenced by the Gulf Stream. It is very changeable, with heavy storms both winter and summer. The annual rainfall is 42 inches; the annual mean temperature is 33° F.; the number of frosty days about one hundred and ninety. The ground is much broken with rocks and ravines, between which are patches of heather and bogs covered with arctic plants and mosses.

There is reason to believe that the balance of the animals will become acclimated at Skaaroe, and the experiment thus prove successful, provided they survive the present winter.

By what I learn from reports of whalers and from people who have been members of polar expeditions, the musk ox is likely to become extinct, like the buffalo, in the course of time, unless something is done for its protection. I have been informed that one single ox has been kept at the zoological gardens at Copenhagen some three years, one also at Berlin, and two are found in the possession of a private party in Sweden. All of these are said to thrive well. I presume some animals are also kept in other places. It would then appear rational to believe that the species could become acclimated, or possibly even domesticated, under favorable conditions and with proper management.

Below is the letter written to the Trondhjems Adresseavis mentioned above:

Regarding the article in your valued paper last Tuesday evening, taken from Trondhjems Adresseavis, I will take the liberty to give the following information:

The female mentioned—the smallest of them brought over—was ailing as early as last August, immediately after arrival at Skaaroe. It was then treated by a veterinary surgeon, who pronounced the disease ischury, which was readily cured. It is possible that the same disease has reappeared, without being understood by the attendant, or the animal may have suffered from the effects of a shot wound, hidden by the thick wool, and that this was the cause of its death. The animals do not roam at large on Skaaroe and care for themselves, but they are placed in a quite large

inclosure, where they are fed. The result of this has been that the animals have had insufficient exercise, whereby the hoofs have had too slight wear. The ox has from this cause been indisposed of late. The hoofs have now been trimmed, after which its condition appears to have become very good, as appears from telegram of the 13th instant.

I entertain meanwhile no doubt but what musk oxen may be successfully acclimatized in Norway for a beginning in the northern territory.

That the musk ox, with its abundance of wool, its great strength, its hardiness and frugality, would become of importance to our farmers can not be doubted. The trouble is that the experiments are too expensive for private persons. The interest in these experiments is very great in Sweden, wherefore Swedish scientific people have tried to obtain the animals now at Skaaroe. This seems to favor my idea about the acclimation of musk oxen, etc.

Other information concerning the musk ox may be found in the Annual Reports of the Bureau of Animal Industry for 1901 (pp. 507–512) and 1902 (p. 484).

Ostrich farming in Australia.—Ostriches have been introduced into Australia, and the experiment of their acclimatization and rearing has proved highly successful. Twenty-two of the birds were brought from Africa and were placed on a farm near Sydney. They are fed on rice, Indian corn, and vegetables, requiring but little water. They lay eggs about three times a year, and from twenty to thirty eggs at each laying period. The birds mature in two and a half to three years. Those raised in Australia produce magnificent feathers, pure white, measuring 27 inches in length by 15 inches in width. Our southwestern Territories (Arizona and New Mexico) might prove profitable fields for ostrich farming.—(*Simon W. Hanauer, deputy consul-general, Frankfort, Germany, August 29, 1903.*)

Hides in Java.—Hides play an important rôle in the export trade of Java. Buffalo hides are well prepared, so that in quality they are better than those of British India and the other islands of the East Indian Archipelago. These hides are exported to Amsterdam, whence they go in large quantities to Germany. The poorer quality find their way via Singapore to England, where, under the name of "Singapore buff," they are known as an inferior article. Hides of cattle are also exported and are of good quality, being on the whole thinner and more tender than European cattle hides. All hides are well stretched and sun dried; other preservatives, such as salt, are not used.

Goatskins in Java.—The export of goatskins has become very important during the past fifteen years and amounts to more than $500,000 per annum, although the official statistics show a much smaller figure, owing to the low value placed upon the skins in computing the export duty. The United States is the best customer for goatskins, even the greater part of the large quantities of skins consigned to Amsterdam finding its way thither.—(*Walter Schumann consul, Mainz, Germany, July 23, 1903.*)

Austrian rice for horse feed in the United States.—A considerable quantity of granulated rice and rice flour was exported from Trieste to New York and Philadelphia during the past year. This article is laid down in the United States at from 1¼ to 1½ cents per pound, and is said to be used for horse feed in the Eastern States.—(*Frederick W. Hossfeld*, *consul*, *Trieste*, *Austria*.)

Sheep-feeding plant in Washington.—By the courtesy of Mr. Thomas H. Rutter, of North Yakima, Wash., the Bureau of Animal Industry has received the information contained herein and the photograph shown on Plate XXII. This feeding plant, which is the only one of the kind in Washington, is owned by the Cameron Brothers, of North Yakima, and consists of feed yards, barn, hay-cutter, engine, and a 7-inch pipe, through which the cut alfalfa is delivered into the barn, being forced upward by a blower. There the cut hay and threshed wheat are mixed in the proportion of 2½ pounds of the former to 2 pounds of the latter. The wheat does not settle to the bottom, as one one might suppose. The feed is supplied to the sheep through numerous chutes. By this method three men are able to feed as many as 6,000 sheep. The owners claim that this method of feeding insures the quickest fattening and minifies the waste.

Sweepstakes Angoras.—The sweepstakes Angora buck and doe at the annual exhibit of the American Angora Goat Breeders' Association, at Kansas City, last October, are shown on Plate XXII. They are both from South African bucks, which were imported by Wm. M. Landrum, in 1901, and in many respects represent the ideal Angora. They were shown by Frank O. Landrum, of Laguna, Tex. The buck was sold in the ring, and was purchased by Messrs. E. L. Witt & Sons of Montell, Tex., at the price of $1,300.

CONTAGIOUS DISEASES OF ANIMALS IN FOREIGN COUNTRIES.

By George Fayette Thompson, M. S.,
Editor, Bureau of Animal Industry.

GREAT BRITAIN.

The following report of the contagious diseases of domestic animals in Great Britain is from the report of the British Board of Agriculture for the year 1902:

SWINE FEVER.

It is satisfactory to record that the number of outbreaks of swine fever in Great Britain for the 52 weeks ended December 27, 1902 (the statistical year), fell to 1,688 as compared with 3,140 in the corresponding period of the previous year. Since the Board commenced their operations against this disease in 1893 the lowest returns for corresponding periods had been 2,155 in 1897 and 1,940 in 1900. The figures for 1902 show, therefore, a decline of 252 outbreaks as compared with the lowest figures previously recorded.

SHEEP SCAB.

As regards the prevalence of sheep scab, 1,664 outbreaks were reported in Great Britain during the year, a slight increase over the 1,537 reported in 1901. The figure, however, still compares favorably with that of 1900, which was 1,939. In England there has been a noticeable improvement, there having been 691 outbreaks confirmed by the local authority in 38 counties, as against 737 outbreaks in 41 counties in 1901. In Wales the outbreaks increased from 696 to 779, one county less being involved than in 1901; in Scotland from 104 to 194, three more counties being involved.

GLANDERS.

From an administrative point of view there is nothing of special interest to chronicle with regard to glanders. There was a slight decrease in outbreaks as compared with 1901, viz, 1,155 as against 1,347. The disease remains prevalent in the same districts as before, namely, London and the home counties, and the areas round other populous centers such as Liverpool and Glasgow. There was a decrease from 1901 of the number of outbreaks in the county of London of 154 (from 1,009 to 855), which may be regarded as a satisfactory feature.

ANTHRAX.

The cases of anthrax showed a slight increase, rising to 678. The method of destroying the carcasses by burning, alluded to in the report of last year, is being more generally adopted, and the results have given satisfaction. The local authorities in ten counties have obtained the necessary licenses for cremation from the Board. An extension of the practice seems desirable and will, no doubt, be gradually brought about.

DENMARK.

With the report for September missing from our records, the condition of diseases of domestic animals in Denmark in 1903 was not very different from that of 1902, except the increase in hog diseases.

Outbreaks of contagious diseases among domestic animals in Denmark for the year 1903.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.
Anthrax	16	8	14	14	11	4
Cerebro-spinal meningitis	1	1	4	5	3	2
Glanders	......	......	......	......	2	......
Malignant catarrhal fever	8	13	6	13	8	8
Hog cholera and swine plague	2	3	2	2	6	1
Rouget:						
Acute	19	16	14	30	26	43
Chronic	7	7	5	8	11	15
Nodular erythema	56	54	52	109	97	273
Foot rot	1	......	......	......	......	......

Name of disease.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Anthrax	4	3	......	5	12	20	111
Cerebro-spinal meningitis	......	1	......	1	2	2	22
Glanders	1	4	......	6	3	1	17
Malignant catarrhal fever	8	11	......	7	4	5	91
Hog cholera and swine plague	4	2	......	5	4	5	36
Rouget:							
Acute	62	82	......	105	68	53	518
Chronic	14	28	......	38	48	42	223
Nodular erythema	552	873	......	831	384	169	3,450
Foot rot	......	......	......	......	......	......	1

BELGIUM.

The contagious diseases of domestic animals in Belgium in 1903 were neither numerous nor extensive. The most important disease reported upon was foot-and-mouth disease, of which there were 43 premises; in 1902 there were 870.

Cases of contagious diseases of domestic animals in Belgium in 1903.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.
Glanders and farcy	1	4	......	1	3	6
Foot-and-mouth disease	6	8	3	......	2	1
Rabies	2	2	5	10	4	4
Anthrax	23	23	30	27	29	23
Foot rot	......	......	......	......	59	......

Name of disease.	July.	Aug.	Sept.	Oct	Nov.	Dec.	Total.
Glanders and farcy	1	2	4	12	6	1	41
Foot-and-mouth disease	1	2	1	......	......	1	25
Rabies	2	2	2	4	3	3	43
Anthrax	32	40	28	33	27	19	334
Foot rot	1	14	187	58	......	......	319

FRANCE.

It seems that in France the authorities are gradually getting the upper hand of the foot-and-mouth disease. The outbreaks, which numbered 37,397 in 1901, were reduced to 9,152 in 1902 and to 1,454 in 1903. In this number are included 25 outbreaks reported from Algeria. The total cases of rabies continue large, the number being 2,363; this is 28 larger than in 1902.

Contagious diseases of domestic animals in France in 1903.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.
Pleuro-pneumonia:						
Number of outbreaks	1	....	5	....	....	1
Number slaughtered	4	....	4	....	....	1
Foot-and-mouth disease (outbreaks)	437	505	234	82	14	53
Sheep scab (outbreaks)	47	13	4	7	26	9
Sheep pox (outbreaks)	12	3	16	3	15	31
Anthrax (outbreaks)	27	31	26	27	28	28
Blackleg (outbreaks)	52	57	50	39	39	42
Glanders and farcy:						
Number of outbreaks	50	46	69	47	54	55
Horses slaughtered	66	58	75	62	67	57
Rabies (cases)	172	177	344	269	190	196
Rouget (outbreaks)	27	20	21	20	25	37
Hog cholera (outbreaks)	17	14	22	12	19	14

Name of disease.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Pleuro-pneumonia:							
Number of outbreaks	....	3	....	1	....	1	12
Number slaughtered	....	6	....	1	....	1	17
Foot-and-mouth disease (outbreaks)	46	33	21	14	11	4	1,454
Sheep scab (outbreaks)	44	11	4	4	8	10	187
Sheep pox (outbreaks)	39	35	27	14	5	8	208
Anthrax (outbreaks)	66	36	47	46	25	29	416
Blackleg (outbreaks)	44	51	69	101	97	85	726
Glanders and farcy:							
Number of outbreaks	49	52	45	35	35	41	578
Horses slaughtered	71	65	46	39	40	49	695
Rabies (cases)	188	164	179	201	129	154	2,363
Rouget (outbreaks)	38	74	69	72	53	53	509
Hog cholera (outbreaks)	12	14	15	31	32	32	224

SWITZERLAND.

The only material change in the status of contagious diseases of animals in Switzerland in 1903 from the previous year is the great reduction in the cases of foot-and-mouth disease. In 1902 the reports showed 15,531 cases, while in 1903 the number was but 659. This indicates that such attention is being given to this disease as will very soon eradicate it altogether.

Cases of contagious diseases of domestic animals in Switzerland for the year 1903.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.
Blackleg	6	9	14	15	17	69
Anthrax	40	29	29	29	24	19
Foot-and-mouth disease	180	137	57	7	......	......
Rouget	123	68	62	97	106	180
Sheep scab	77	7	2	......	1	29
Tuberculosis	5	3	6	3	14	12
Rabies	......	......	1	......	1	......
Glanders and farcy	......	2	......	......	4	5

Name of disease.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Blackleg	172	144	117	74	24	12	673
Anthrax	20	27	26	33	17	23	316
Foot-and-mouth disease	100	23	......	......	56	106	666
Rouget	275	367	314	282	135	174	2,183
Sheep scab	......	......	......	220	5	......	341
Tuberculosis	5	......	3	1	3	......	55
Rabies	1	1	......	6	......	1	11
Glanders and farcy	......	......	......	1	2	2	16

NETHERLANDS.

Netherlands makes a good showing when comparing 1903 with the previous years. In 1902 she had 900 cases of foot-and-mouth disease, but in 1903 there was but 1 case, and that so long ago as May of that year.

Cases of contagious diseases of domestic animals in Netherlands in 1903.

Name of disease.	Jan.	Feb.[a]	Mar.	Apr.	May.	June.
Foot-and-mouth disease	......	......	......	......	1	......
Glanders and farcy	......	......	......	2	1	1
Sheep scab	114	......	64	950	71	463
Foot rot	17	......	25	10	25	45
Rouget	20	......	24	25	47	113
Anthrax	32	......	40	40	34	19
Rabies	2	......	6	5	4	3
Trichina	......	......	......	5	......	......

Name of disease.	July.	Aug.	Sept.	Oct.	Nov.	Dec.[a]	Total.
Foot-and-mouth disease	......	......	......	......	......	......	1
Glanders and farcy	......	2	1	2	4	......	13
Sheep scab	211	208	328	114	364	......	2,887
Foot rot	165	204	117	76	54	......	738
Rouget	371	590	283	181	70	......	1,724
Anthrax	24	25	18	33	47	......	312
Rabies	5	......	......	......	......	......	25
Trichina	......	......	......	......	......	......	5

[a] Report for month not received.

GERMAN EMPIRE.

The continuance of pleuro-pneumonia and foot-and-mouth disease in Germany is an unpleasant feature of the German report for 1903. However, these diseases were not so prevalent as during the previous year. In 1902 the farms reporting foot-and-mouth disease numbered 3,087; in 1903, the number was 1,942.

Number of localities and farms infected with contagious diseases of domestic animals in Germany during the year 1903.

Name of disease.	Jan.	Feb.	Mar.	Apr.	May.	June.
Glanders and farcy:						
Localities	20	18	14	42	46	37
Farms	21	20	15	48	50	39
Pleuro-pneumonia:						
Localities	2	1	....	....	4	2
Farms	2	1	....	....	4	2
Foot-and-mouth disease:						
Localities	29	61	40	39	41	50
Farms	53	89	69	93	129	183
Hog cholera and swine plague:						
Localities	694	814	1,029	2,281	2,334	2,416
Farms	887	1,040	1,328	2,980	3,028	3,447

Name of disease.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Glanders and farcy:							
Localities	61	65	63	60	60	57	543
Farms	68	75	72	69	65	64	606
Pleuro-pneumonia:							
Localities	2	1	....	....	....	....	12
Farms	2	1	....	....	....	....	12
Foot-and-mouth disease:							
Localities	48	61	117	79	43	35	643
Farms	181	214	424	240	86	181	1,942
Hog cholera and swine plague:							
Localities	2,399	2,430	2,393	2,265	2,305	2,347	23,707
Farms	3,190	3,180	3,165	2,904	3,058	3,239	31,446

ITALY.

Last year attention was called to the marked increase in the number of cases of anthrax in 1902 over the previous year; this increase was from 2,500 to 5,697. During 1903 some good work was evidently done against this disease, for the total number of cases reported was 874 only. Of this number, 733 occurred in the months of August, September, and October. In December there were no cases whatever. Last year the number of cases of foot-and-mouth disease was 10,999, which shows a very large reduction from 1902, when the number of cases was 35,263. There was a very large increase in the number of cases of sheep scab—from 30,421 in 1902 to 754,702 in 1903.

There was a considerable decline in the number of cases of hog cholera and swine plague, but a very large increase in agalassia contagiosa, a disease which affects both sheep and goats. In 1903 the number of cases was 78,729, being an increase from 27,273 in 1902.

Number of cases of contagious diseases of animals in Italy during the year 1903.

Name of disease.	January.	February.	March.	April.	May.	June.
Anthrax	2	5	2	3	5	13
Blackleg	6	3	2	35	8	12
Foot-and-mouth disease	650	426	1,047	236	678	873
Tuberculosis	18	18	22	13	15	11
Glanders and farcy	106	124	192	165	175	97
Rabies	....	....	....	3	1	8
Scab	51,927	54,315	89,303	75,758	98,616	60,877
Hog cholera and swine plague	500	431	806	893	1,776	1,582
Barbone of buffalo	....	....	....	....	....	....
Agalassia contagiosa	3,655	662	8,687	9,935	7,534	4,777
Sheep pox	....	....	....	....	51	66

Name of disease.	July.	August.	September.	October.	November.	December.	Total.
Anthrax	93	376	238	120	17	....	874
Blackleg	22	6	5	6	2	....	107
Foot-and-mouth disease	657	1,063	388	831	2,282	1,868	10,999
Tuberculosis	8	7	4	3	5	4	128
Glanders and farcy	71	94	49	56	58	42	1,229
Rabies	1	....	2	3	3	12	33
Scab	69,124	73,255	53,333	40,915	42,731	44,548	754,702
Hog cholera and swine plague	2,306	2,045	475	424	765	1,673	13,676
Barbone of buffalo	60	1	2	....	....	....	63
Agalassia contagiosa	16,276	6,546	4,227	2,452	7,604	6,374	78,729
Sheep pox	51	35	....	....	....	....	203

HUNGARY.

The report here presented for Hungary is for the year 1902. It shows the number of animals affected:

Cases of contagious diseases of domestic animals in Hungary in 1902.

Name of disease.	Horses.	Cattle.	Sheep.	Hogs.
Anthrax	381	3,981	416	28
Rabies	18	147	25	154
Glanders and farcy	823	....	....	....
Foot-and-mouth disease	....	263,623	49,872	8,926
Blisters upon genitals	192	1,177	....	....
Scab	4,021	8,954	1,643	....
Rouget	....	....	....	31,031
Hog cholera and swine plague	....	....	....	227,302

INDIA.

The following refers to an outbreak of surra in India which was reported in the Indian Agriculturist, published at Calcutta, India, under date of February 1, 1904:

The surra that had broken out in Jallabad and other lands parallel to the Sutlej all along the district, in November last, has practically put an end to the Mandot stud at Jallabad, as out of some 52 animals only a few of the young stock have been saved. These were wisely sent away, when healthy, to some high and dry land a few miles off by the local authorities before the veterinary and remount authorities came to Jallabad. Captain Brown, of the remount department, Lahore, and the assistant to the imperial bacteriologist were at Jallabad for about a week, and after examining all the animals pronounced the disease to be incurable, and they were destroyed and incinerated by the estate. Very many rural breeders have lost all their animals. They did not destroy any, but let them die off. No new cases have been reported during the last week of December, and both the zemindars and some veterinary authorities say that surra generally disappears about or in the month of January, and hardly ever appears after that.

EGYPT.

A serious outbreak of bovine typhus—also known as "cattle plague" and "rinderpest"—occurred in Egypt in the early summer of 1903. The part of the country affected at that time was the northern or Delta portion, known as Lower Egypt. Cases were first observed in the early part of June, and about the middle of the month the disease was noted among the army cattle at Cairo, and also among other cattle brought to the abattoirs of that city for slaughter.

Previous visitations of the plague, in 1865 and 1881–1883, served as warnings that prompt action was necessary to avoid serious loss among the cattle of the country; the authorities therefore at once introduced strong repressive measures with a view to confining the disease to the smallest possible area and eventually stamping it out. All the cattle markets were closed, also all bridges and ferries, and all exports of cattle were stopped; veterinary inspectors were sent out to the various districts which reported the disease, and they instructed the local authorities how to deal with the cases; but the disease spread alarmingly in spite of all that could be done to prevent it. On July 5, less than a month after its discovery, it was reported in 62 localities, distributed over nine provinces—practically all of Lower Egypt. It is highly probable that the infection had taken considerable hold in the country before the authorities had become cognizant of the situation, and it was found a very difficult task to cope with it successfully, owing to the carelessness and lack of cooperation of many of the owners and village authorities. It was hoped, however, by using great vigilance and instituting severe penalties for concealing cases, to prevent, at any rate, the disease from spreading into Upper Egypt, but this effort proved unavailing, as will be seen later.

Symptoms and treatment.—The principal symptoms of the disease are: High temperature, 104° to 107° F.; staring coat; animal always seeking shade; rumination arrested; dribbling of saliva; ulceration of mouth, tongue, and nose; inflammation of vagina; diarrhea; very rapid loss of flesh; fecal matter very fetid and often dark colored; hurried and labored respiration; sometimes blood in feces and urine; loss of milk in milch cows; frequent abortion of cows in calf.

The disease is usually very virulent, causing a mortality as high as 80 to 90 per cent, and no medical treatment seems to be of any avail. The only advice that the sanitary administration of Egypt could give to the cattle owners was in the line of attention to the sick animals and proper diet. It was stated the death rate could be kept down to some extent by good care and careful feeding, the best way being to leave the animals in the shade in the open air and feed them green food and strengthening gruel at regular intervals.

Combating the outbreak.—The method of dealing with the outbreak was by isolating and destroying the infected animals and immunizing all others in the area affected. There are two methods of immunization—both by inoculation—the one with bile and the other with serum; the latter may be used alone, but it is considered more effective to use it in conjunction with infected blood, 1 c. c. or more of the blood being injected into one side of the animal and 25 to 80 c. c. or more of serum into the other side. The bile is procured from the gall bladders of animals which had been sick with the disease, 10 c. c. being the quantity injected. The gall method is slower than the serum and is recommended when the latter can not be procured, or in localities not actually infected, thus giving the bile the necessary seven to ten days in which to become effective.

Reports show that the use of the serum and blood was wonderfully effective; the Government, however, had only a small quantity on hand when the epidemic started and immediately established a farm for the purpose of producing it. In the meantime supplies were sent for from India, South Africa, and Constantinople, all of which countries are subject to the plague and which manufacture the serum. The Turkish serum was the first to arrive, but turned out to be either inefficient or else was not properly used; at any rate a large number of animals died as a direct consequence of inoculation with it. It will be seen by the table below that the heaviest mortality occurred during the week ended July 26; out of the total for the week it was estimated that about 400 died as a result of using Constantinople serum. This unfortunate incident had a retarding effect on the prophylactic measures and the mortality remained high for some weeks, inoculation with serum was naturally looked upon with disfavor, and it was some time before confidence in the treatment was fully restored. However, later reports from the various districts seemed to indicate that the

progress of the epidemic was being successfully checked, as may be seen from the following weekly figures taken from the official reports:

Table showing number of localities affected and number of animals died, slaughtered, and inoculated weekly, from July 5 to September 6.

	Localities infected.	Died.	Slaughtered.	Inoculations.	
				Bile.	Serum.
July 5	62	67	126	3,476	2,337
July 12	38	87	108	1,901	1,310
July 19	137	252	105	1,411	696
July 26	133	[a] 709	95	2,783	167
August 2	83	445	98	756	29
August 9	68	371	50	138	5
August 16	83	434	31	90	303
August 23	44	308	29	308	574
August 30	66	380	17	97	780
September 6	50	334	9	0	550
Total for 10 weeks	764	3,387	668	10,960	6,751

[a] At least 380 died from use of ineffective serum.

At this stage the situation was considered so hopeful that it was proposed very shortly to reopen the cattle markets.

There are no reports on hand after the one dated September 6—the last one in the table—until the first week in December, a lapse of three months. It appears from the latter report that the outbreak in Lower Egypt had been fully controlled, had in fact practically subsided, out that the endeavor to prevent its spread into Upper Egypt had signally failed, as it was then raging with great virulence in that locality. The report in question states that while there were 80 deaths from the plague in Lower Egypt (indicating a slight reappearance in that part of the country), it was strongly in evidence in Upper Egypt, upward of 800 head having succumbed in the first week of December.

It was explained that the greater severity of the outbreak in Upper Egypt was due to the fact that the disease is more deadly in winter than in summer, the warmth of the sun having power to reduce the virility of the microbe.

IMPORTS OF MEAT, MEAT PRODUCTS, EGGS, AND DAIRY PRODUCTS INTO THE UNITED KINGDOM.

By George Fayette Thompson, M. S.,
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The United Kingdom is recognized as the best market in the world for food products, and it is therefore natural that those countries which produce a surplus of such products should engage in keen competition for the trade of that country. The countries principally concerned in the meat, egg, and dairy-products supply are the United States, Australasia, Argentina, and Denmark.

IMPORTS OF THE UNITED KINGDOM.

In order that we may know the extent of the market for the products under consideration, at least so far as importations comprise the market, the following table is compiled from the official reports of the United Kingdom for the year of 1903. The statistics for the years 1901 and 1902, also from the same source, are also given for purposes of comparison:

Imports for the years 1901 to 1903.

Article of import.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cattle ....number..	495,635	$43,023,091	419,488	$38,030,495	522,546	$44,816,192
Sheep and lambs ...do....	383,594	2,852,445	293,203	2,211,445	354,241	2,657,416
Fresh beef ......pounds..	504,979,552	43,345,132	415,227,344	38,470,383	465,875,872	40,713,825
Fresh mutton......do....	404,121,648	32,109,556	409,875,088	33,651,414	449,861,664	38,085,531
Fresh pork.........do....	88,649,008	8,349,274	73,402,112	7,036,665	79,054,528	7,569,607
Bacon..............do....	646,502,976	66,136,592	570,046,848	62,242,335	577,582,656	66,277,545
Hams ....do....	208,395,040	22,037,400	166,016,144	18,779,833	127,829,184	15,293,336
Salted beef.........do....	22,892,352	1,301,088	17,200,288	1,187,436	19,453,504	1,195,236
Salted pork (not bacon or hams).........pounds..	27,669,264	1,577,564	22,989,008	1,487,139	26,609,296	1,553,698
Poultry and game..do....	....	4,772,854	....	5,153,916	....	5,854,818
Rabbits ....do....	43,889,104	3,157,512	50,563,184	3,573,598	53,272,240	3,522,767
All other meat.....do....	....	....	....	....	74,285,232	5,869,739
Tallow and stearin, pounds	199,955,728	11,354,742	199,594,976	13,181,971	156,259,488	9,674,042
Butter ....pounds..	414,723,680	93,910,778	445,192,496	99,899,191	454,796,608	101,216,903
Cheese ....do....	289,725,744	30,304,352	285,175,744	31,206,042	301,751,968	34,329,775
Margarine ....do....	107,758,224	12,442,078	108,211,040	12,504,243	98,917,616	11,272,537
Lard ....do....	220,220,672	19,649,414	184,967,660	20,045,065	194,064,080	18,837,487
Condensed milk ...do....	102,963,728	8,567,551	102,331,600	8,795,474	102,576,432	8,463,223
Salted or fresh meat unenumerated...pounds..	68,350,352	5,452,655	73,362,576	5,835,469	74,285,232	5,869,739
Preserved meat other than salted ...pounds..	86,166,976	11,106,837	102,071,872	13,559,013	85,966,384	11,853,947
Oleomargarine or oleo oil ....pounds..	18,779,040	1,454,159	16,144,128	1,425,826	....	....
Eggs... ....dozens..	170,717,670	26,745,150	189,667,950	30,702,676	198,488,970	32,204,643
Total	....	449,650,224	....	448,979,629	....	467,132,006

Cattle.—The imports of cattle into the United Kingdom in 1903 amounted to 522,546 head, and their value was $44,816,192. The table above shows that the imports for this year exceeded those of 1902 by more than 100,000 head and six and three-fourths million dollars. Of the cattle supply of 1903, the United States furnished 301,757 head, which was a decrease of 22,674 head from the number of the year before, and of 103,947 from 1901. The reason for this decline is not due to foreign competition, but to the shortage of supply for the home demands. Our chief competitor in this cattle trade is Canada, which sent 190,815 to the United Kingdom in 1903; this was an increase over 1902 of over 100 per cent. Argentina was shut out of that market during 1901 and 1902 and nine months of 1903. During the three months that cattle were admitted she sent 27,817 head. The absence of imports from Argentina during the two years named was because of the existence of foot-and-mouth disease in that country. The last full year of exports of cattle from Argentina to the United Kingdom was 1898, when the number was 89,369, valued at $6,575,926.

The value per head of the cattle sent from the United States in 1903 was $87; those from Canada for the same year were worth $84.40 per head, and those from Argentina $79.71.

The United States, Canada, and Argentina furnish nearly all the imports of cattle.

Sheep and lambs.—The total number of sheep and lambs received as imports into the United Kingdom in 1903 was 354,241, and they were valued at $2,657,416. This was an increase over 1902, but a decrease from 1901. For the year 1903 the United States furnished the United Kingdom with half of the sheep and lambs imported, but this was possible because Argentine sheep were shut out of that market for a long time, as explained above. In 1898 this country furnished 430,073 head, and 382,080 head in 1899. Argentina sent 82,941 head during the three months of 1903 that the markets were open to her. Canada sent 83,291 head in 1903. All other countries sent but 16,623 head.

The exports from the United States were fewer in 1903 than in 1902 by 61,841 head, and fewer than in 1901 by 128,766. This falling off is due to the high prices which have ruled in the home markets and not to any lack of demand in the United Kingdom for American mutton.

The value per head of those sent from the United States in 1903 was $7.51; from Argentina, $7.85; from Canada, $7.54.

Fresh beef.—The amount of fresh beef imported in 1903 was 465,875,872 pounds, and its value was $40,713,825. This quantity is less than the imports of 1900 and 1901, but 50,000,000 pounds greater than in 1902. The decrease was not because of the lack of demand, but because of the shortage of American and Australasian supply.

Of the total imports, the United States sent 301,719,040 pounds; Argentina sent 129,047,632 pounds, and Australasia sent 26,598,432 pounds.

In the matter of price the United States leads, receiving 1.5 cents more per pound than Argentina and 2 cents more than Australasia. The United States received 9.2 cents per pound for its sales, Argentina 7.7 cents, and Australasia 7.2 cents.

Over two-thirds of the Australasian supply (271,247 pounds) is from New Zealand.

Fresh mutton.—The imports of fresh mutton in 1903 amounted to 449,861,664 pounds and its value was $38,085,531. This was 40,000,000 pounds more than was imported in 1902 and 45,000,000 pounds more than the imports of 1901. Of this great quantity, New Zealand in 1903 sent 227,968,608 pounds, receiving for it $20,211,884—8.8 cents per pound. Argentina sent 166,406,240 pounds, receiving for it $12,672,030—7.6 cents per pound. Australia sent 20,302,128 pounds; and that from the United States was included under the head of "Other countries." The amount was no doubt quite small, being but 200,592 pounds in 1902. Our exports of mutton to all countries in 1903, according to the records of the Bureau of Statistics of the Department of Commerce and Labor, were only 2,780,265 pounds, with a value of $253,384—8.7 cents per pound. The price per pound of that sent to the United Kingdom in 1902 was only 7.5 cents.

Fresh pork.—The imports of fresh pork are not great when compared with the imports of fresh beef, fresh mutton, bacon, and hams. The amount for 1903 was 79,054,528 pounds. This was 6,000,000 pounds greater than the amount for 1902, but 9,500,000 pounds smaller than that for 1901. The value of the imports of 1903 was $7,569,607—9.8 cents per pound. The largest part of this supply came from Holland, the amount for 1903 being 59,054,128 pounds, with a value of $5,461,196. The United States is the second in rank, sending 14,861,840 pounds, having a value of $1,555,499. Belgium has a small trade with the United Kingdom in fresh pork.

The fresh pork from Holland brought 9.2 cents per pound, while that from the United States brought 10.6 cents.

Bacon.—With one exception, bacon is the article imported in largest quantity, and the countries competing for this trade are the United States, Denmark, and Canada. The total amount imported in 1903 was 577,582,656 pounds, worth $66,277,545. The United States contributed 324,072,784 pounds of this, and the value of it was $35,870,621—11 cents per pound. The amount furnished by Denmark was 167,563,312 pounds, worth $20,896,834—12.4 cents per pound. Canada sent 74,507,888 pounds, worth $8,232,595—11 cents per pound.

These figures prove that Canadian bacon is not worth more than ours in the English markets, but what of that from Denmark, which

brings 1.4 cents more than that from the United States? The reasons for this will be touched on elsewhere in this article. If our bacon had sold for the same price as the Danish article in 1903, we would have received $4,537,019 more than was received. It is a fact also that our exports of bacon to that market have been decreasing all too rapidly in recent years, while those from Denmark have been increasing. A tabular statement is given herewith for the purpose of comparing our losses and Denmark's gains.

Imports of bacon from the United States and Denmark.

Year.	United States.	Denmark.
	Pounds.	*Pounds.*
1901	475,364,848	118,821,806
1902	367,791,760	140,630,224
1903	324,072,784	167,563,312

Hams.—In 1903 the United Kingdom imported 127,829,184 pounds of hams. This was 38,186,960 pounds less than the imports of 1902 and 80,565,856 pounds less than those of 1901. The value of the hams taken in 1903 was $15,293,336. The United States has very little competition in this article. The amount she contributed in 1903 was 105,186,928 pounds, worth $12,665,817—12 cents per pound. The contribution of Canada was 22,119,664 pounds, receiving for it $2,552,684, or 11.1 cents per pound. All other countries furnished but 522,592 pounds. There is no plausible explanation as to why the imports of hams into the United Kingdom should be falling off nor why the exports from the United States should not be maintained at the highest point and increased annually, but this is not the case.

Rabbits.—The people generally of the United States have no idea of the amount of rabbit meat that is consumed in the United Kingdom. There are no data available to show either the domestic production or consumption, which is no doubt considerable; but that which was imported in 1903 amounted to 53,272,240 pounds, and it was valued at $3,522,767, or 6.6 cents per pound. Of this Australia sent 27,312,768 pounds, worth $1,390,447—5.1 cents per pound; New Zealand sent 15,027,152 pounds, worth $777,457—5.7 cents per pound; Belgium sent 7,716,192 pounds, worth $963,324—12.5 cents per pound. The Belgium rabbits are the domestic sort, while those from Australasia are of the wild kind. This fact explains why Belgium gets for her rabbits more than twice the amount received by the other countries. If the United States sends any rabbits to the United Kingdom, the amount is so small as not to be mentioned separately; it is not probable that we export any whatever.

Lard.—Lard is an article of importation into the United Kingdom that is of much importance. The total imports for 1903, for instance, amounted to 194,064,080 pounds, and it was worth $18,837,487. This was at the rate of 9.7 cents per pound. The United States has no important competition in that market for this product; all other imports amounted to 15,980,832 pounds only.

Margarine.—This is the well-known substitute for butter, and in the United States usually goes under the name of "oleomargarine;" but in the United Kingdom the latter terms appears to mean "oleo oil," and not the butter substitute. The amount of margarine imported by the United Kingdom in 1903 was 98,917,616 pounds, having a value of $11,272,537. It does not appear from the English records that the United States has any part in this trade; practically all of it is with Holland. That country sent 94,420,032 pounds, receiving for it $10,650,321. This was at the rate of 11.3 cents per pound.

Tallow and stearin.—The figures for tallow and stearin for 1903 are not at hand, but it is an item of considerable importance in the imports of the United Kingdom. The table at the beginning of this article shows what the amounts were for 1901 and 1902. Over a dozen countries contribute to this supply. The statement below shows for 1902 the leading countries furnishing tallow and stearin and also the amounts sent by each one:

Tallow and stearin imported in 1902.

	Pounds.
Argentina	75,670,560
New Zealand	72,833,152
New South Wales	47,393,584
Queensland	22,457,488
United States	21,852,656
Uruguay	15,222,928

Butter.—The largest article of import of the kind under consideration was butter. The enormous amount of 454,796,608 pounds were received into the United Kingdom in 1903, and it was valued at $101,216,903. This amount was 9,604,112 pounds greater than in 1902 and 40,072,928 pounds greater than in 1901. Nearly half of this butter was from Denmark, the amount being 198,525,248 pounds, having a value of $46,584,274—28.4 cents per pound. The receipts from Russia are second in importance, with those from France a close third. Russia's amount was 54,344,736 pounds and the value $10,661,060—19.6 cents per pound. France's supply was 50,857,856 pounds, valued at $11,443,093—22.5 cents per pound. The United States supply was 4,749,360 pounds, valued at $927,934—19.5 cents per pound.

So many countries are furnishing large supplies of butter to the United Kingdom that the following table showing these countries and the quantity and value is given for use of comparison and study.

Imports of butter, 1901 to 1903.

Country of export.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
Russia	42,386,848	8,055,771	54,890,192	10,687,973	54,344,736	10,661,060
Sweden	21,183,744	4,569,103	21,458,192	4,846,246	23,769,984	5,396,851
Denmark	178,884,832	43,557,594	190,739,584	45,269,945	198,425,248	46,584,274
Germany	3,022,096	730,977	2,954,000	707,584	1,400,672	317,125
Holland	33,478,144	7,356,026	44,045,232	9,606,130	38,497,200	8,364,015
France	34,899,312	8,293,139	46,394,880	10,867,488	50,857,856	11,443,093
United States	16,814,112	3,353,817	6,099,296	1,230,611	4,749,360	927,934
Victoria	20,847,792	4,484,504	7,002,128	1,521,161	10,995,824	2,283,206
New South Wales	6,719,664	1,430,347	1,973,552	429,498	2,281,552	484,845
Queensland	5,936	1,265	2,240	506	88,032	18,128
New Zealand	18,742,416	3,988,262	17,695,216	3,804,980	27,986,448	6,058,900
Canada	24,145,856	4,905,442	32,005,680	6,556,854	20,871,968	4,215,601
Other countries	14,637,952	3,184,531	19,932,304	4,364,160	20,727,728	4,461,871
Total	415,768,704	93,910,778	445,192,496	99,893,136	454,996,608	101,216,903

Cheese.—The United Kingdom imported 301,751,968 pounds of cheese in 1903, paying for it $34,329,775. Canada furnished nearly two-thirds of this, the amount being 206,993,024 pounds, valued at $23,471,567—11.3 cents per pound. The United States sent 40,431,592 pounds, receiving for it $4,638,821—11.2 cents per pound. Holland sent 33,864,544 pounds, valued at $3,438,027—11.5 cents per pound. Other contributing countries are France and New Zealand, with unimportant quantities from countries not named.

Eggs.—The imports of eggs have been increasing for several years. In 1903 the amount imported was 198,488,970 dozen, and they were worth $32,214,645. Russia has the lead in this trade. The table below shows the imports from leading countries for a series of years and the price per dozen paid:

Imports of eggs, 1901 to 1903.

Country of export.	1901.		1902.		1903.		Price per dozen, 1903.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Dozens.	*Dollars.*	*Dozens.*	*Dollars.*	*Dozens.*	*Dollars.*	
Russia	44,921,100	5,876,172	53,390,450	7,347,218	68,027,730	9,082,938	13.2
Denmark	30,194,140	5,649,753	35,182,120	6,647,994	38,515,570	8,021,778	20.8
Germany	29,717,770	4,358,554	39,312,800	6,136,029	30,877,510	4,841,278	15.7
Belgium	25,756,420	3,918,705	26,274,570	4,029,043	22,912,620	3,541,522	15.4
France	18,051,960	3,387,692	16,804,330	3,491,587	16,019,400	3,261,061	20.3
Canada	7,040,330	1,245,610	5,178,220	979,704	5,570,800	1,063,676	19
Other countries	15,035,950	2,308,653	13,525,460	203,216	16,565,340	2,402,392	14.5
Total	170,717,670	26,745,139	189,667,950	28,834,791	198,488,970	32,214,645	16.2

THE SUPPLY FROM THE UNITED STATES.

In order that the articles which are supplied by the United States may be seen at a glance, the accompanying table is inserted as a recapitulation of the statistics given in the preceding pages.

Total imports from the United States, 1901 to 1903.

Article of import.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cattle .... number..	405,704	$35,642,995	324,431	$29,902,920	301,757	$26,275,416
Sheep and lambs... do....	300,152	2,555,715	233,227	1,760,408	171,386	1,286,780
Fresh beef ...... pounds..	356,192,592	32,905,263	256,532,080	25,325,543	301,719,040	27,932,493
Fresh pork......... do....	39,080,720	3,713,105	28,271,152	2,785,234	14,861,840	1,555,499
Bacon.............. do....	475,364,848	45,043,599	367,791,760	40,097,634	324,072,784	35,870,621
Salted beef .... do....	21,504,000	1,201,670	16,127,328	1,106,073	18,553,712	1,130,554
Hams .... do....	193,820,032	20,487,070	147,031,248	16,653,182	105,186,928	12,665,817
Salt pork........... do....	15,420,160	1,011,513	11,806,592	910,673	10,175,088	770,453
Meat, salted, unenumerated........... pounds..	19,580,960	1,342,731	18,294,976	1,265,803	20,071,744	1,380,947
Butter .... do....	16,814,112	3,354,817	6,099,296	1,230,611	4,749,360	927,934
Cheese .... do....	60,491,424	6,200,218	43,733,648	4,682,118	40,431,592	4,638,821
Lard .... do....	206,310,048	18,374,252	172,229,120	18,661,280	178,083,248	17,291,784
Oleomargarine[a] ... do....	8,535,927	739,313	6,808,949	667,956	6,602,645	563,866
Eggs............. dozens..	2,594,547	611,442	1,693,720	330,601	....	....
Total	....	173,183,703	....	145,380,036	....	132,290,985

[a] The figures for oleomargarine are from official reports of the United States.

This table should be studied not only by the exporters from the United States, but by the producers of the articles named. If there is an increase in any commodity it will be well to know the exact cause of it, so that further increase may be encouraged. If there is a decrease it is still more necessary to know the exact cause of it, for a constantly falling market means in the end no market whatever. There may be several causes of a diminishing market, such as shortage of supply at home or increased home demands; increased cost of production, making competition with other exporting countries impossible; the development of agricultural conditions of competing countries, like Argentina, where the cost of production is at a minimum.

In order to hold any market our producers must be able to furnish the article demanded in that market, and to provide it in the quality and manner required. Occasional shipments of articles of indifferent quality presages only ruin to the industry. Exporters of machinery find that in order to hold a foreign market for their manufactures they must oftentimes sell at prices below those obtained in the United States. The advantage in this is that the manufacturers from other countries are not permitted to obtain a leading foothold. The producers of meat products must adopt the same principle in order to hold that which we now have. In order that there may not be a continuation

of low prices, or loss of profits rather, means of cheaper production must be adopted. With the stock raiser this means better animals of quick maturity, more rational feeding, and more intensive agricultural conditions. With the producer of cured meats and dairy products it means the same careful study of the foreign market conditions, and vigorous efforts to comply with all those conditions.

The efforts of other countries to divide our trade with the United Kingdom should serve as a spur to the people of the United States. We may well ask ourselves the question whether Canada is really in better condition than we are to raise cattle for the English market? Is there any good reason why Argentina and Australasia, considering their conditions and their distance from the English market, should enjoy all the fresh mutton trade? Should we remain content to produce bacon which is worth 1.4 cents per pound less than that from Denmark? When the United Kingdom requires nearly half a billion pounds of imported butter annually, and when we have the conditions in this country favorable to an enormous increased production, are we to be satisfied with a sale of less than five million pounds? The egg production of the United States is capable of almost indefinite expansion, yet our exports to the United Kingdom were so small as not to be separately stated, and our total exports to all countries amounted to 1,456,342 dozens only ($316,211), and this sum should be reduced by 301,868 dozens ($21,850) that were imported.

Arguments like these might be made for almost all of the articles which we send to the United Kingdom. In no particular has the limit of production been reached in this country.

THE SUPPLY FROM DENMARK.

Denmark holds a large place in the British market for her bacon, and her exports of this article to the United Kingdom have been gradually increasing. Danish bacon brings 1.4 cents more per pound in the British market than that from the United States. Denmark's supply of eggs, like its bacon, has been increasing from year to year. The accompanying table, giving the imports into the United Kingdom for three years, affords opportunity for comparison of exports.

The position held by Denmark in this trade is an enviable one, but the reasons of her success are well known, and if her methods are not adopted by the United States we may expect never to have the hold upon the British market that she has.

THE SUPPLY FROM BELGIUM.

The trade of Belgium with the United Kingdom in the matter of meat, meat products, etc., is considerable, as may be seen in the accompanying table. Belgium's principal article of export to this market is butter, but a few other articles equal a value of $1,000,000.

Imports from Denmark, 1901 to 1903.

Article of import.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Fresh beef......pounds..	6,779,696	$536,188	13,242,992	$1,317,084	....	....
Fresh mutton......do....	143,088	57,313	747,376	90,931	....	....
Fresh pork.........do....	287.952	36,917	704,704	72,337	....	....
Bacon..............do....	118,821,806	15,253,831	140,630,224	18,244,534	167,563,312	$20,896,834
Hams..............do....	89,600	11,655	197,456	23,126	....	....
Salted pork not bacon or hams..........pounds..	8,647,632	377,373	8,614,144	407,346	....	....
Meat unenumerated, pounds................	5,726,896	246,770	9,701,216	433,479	....	....
Poultry and game, pounds................	....	1,313	....	2,476	....	....
Lard............pounds..	46.256	44,266	670,544	82,526	....	....
Butter.............do....	178,884,838	43,557,594	190,739,584	45,269,945	198,525,248	46,584,274
Cream.............do....	138,320	20,206	119,280	18,176	....	....
Condensed milk...do....	3,553,760	276,310	....	....	....	....
Eggs............dozens..	30,194,977	5,649,798	35,336,645	6,657,994	38,515,570	8,021,778
Total..............	....	66,069,534	....	72,619,954	....	75,502,886

A comparison of 1903 with the two preceding years can be made with a few items only, owing to the fact that the full returns for that year are not yet available.

Imports from Belgium, 1901 to 1903.

Article of import.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Fresh beef..........pounds..	....	....	509,912	$60,933	....	....
Fresh mutton.........do....	1,344	$136	399,168	42,032	....	....
Fresh pork............do....	4,533,984	477,511	3,881,472	407,433	4,451,440	$476,868
Preserved meat not salted, pounds..................	1,613,696	899,383	2,520,336	1,449,497	....	....
Other preserved meat, pounds..................	1,851,248	333,375	1,285,648	221,776	....	....
Meat unenumerated, pounds..................	934,976	92,433	799,456	78,468	....	....
Rabbits.............pounds..	8,104,656	999,214	8,686,160	1,001,289	7,716,192	963,324
Poultry and game.....do....	....	1,139,418	....	1,367,793	....	1,339,129
Lard....................do....	165,760	14,599	1,824	335	....	....
Butter.................do....	8,682,912	1,844,501	9,031,232	1,943,588	....	....
Margarine.............do....	716,128	77,723	1,527,296	126,461	....	....
Condensed milk.......do....	1,461,600	123,658	....	....	....	....
Eggs...............dozens..	25,756,420	3,918,705	26,274,570	4,029,043	22,912,620	3,521,522
Total.................	....	9,920,656	....	10,728,648	....	6,300,843

THE SUPPLY FROM AUSTRALASIA.

The imports from Australasia have been hindered by several years of drouth, but even at this time they are of great importance and are likely to increase rapidly now that the drouth is broken. The preliminary statistics do not give, for 1903, figures for all items, but those

for fresh mutton, fresh beef, and butter are available, and these are the three important things imported from that country. The following table shows what Australasia sent to the United Kingdom for the years 1901 to 1903, inclusive:

Imports from Australasia, 1901 to 1903.

Article of import.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
Fresh beef	52,805,088	3,626,983	22,749,104	2,594,404	26,598,432	1,916,023
Fresh mutton	224,767,872	18,990,309	235,658,007	13,442,684	248,270,736	21,990,025
Fresh pork	319,536	30,756	46,928	4,584		
Preserved beef not salted.	6,507,872	929,964	7,012,432	1,014,198		
Preserved mutton	6,109,936	701,676	8,298,864	530,371		
Other preserved meat	5,979,344	1,031,912	4,333,280	323,505		
Salted or fresh meat unenumerated	1,457,904	138,622	1,410,304	143,844		
Rabbits	32,385,584	1,749,385	38,196,144	2,044,548	42,339,920	2,167,904
Butter	46,337,232	9,961,933	26,699,680	5,761,771	41,351,856	9,331,728
Cheese	8,858,528	943,449	5,810,784	63,776	6,309,968	817,917
Oleomargarine	230,384	16,716	66,304	5,762		
Total		38,121,705		25,929,447		36,223,597

THE SUPPLY FROM ARGENTINA.

The principal competitor of the United States in the markets of the United Kingdom is Argentina, especially in the matter of beef. The growth of Argentina's exports along the lines under consideration is confined to a very few recent years, but it has been in a marked degree. The table herewith will show the annual progress of this growth for the years 1898 to 1903, inclusive:

Imports from Argentina, 1898 to 1903.

Product.	1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cattle ....number..	89,369	$6,575,926	85,365	$6,777,083	38,562	$3,248,389
Sheep ....do....	430,073	3,101,849	382,080	2,912,289	178,969	1,406,419
Fresh beef ....pounds..	12,128,256	729,201	16,841,216	975,884	46,173,344	3,247,406
Cured beef ....do....	1,439,312	287,386	1,954,624	140,374	3,696,560	281,649
Fresh mutton ....do....	29,740,816	6,608,347	31,907,232	7,251,455	37,107,840	8,219,898
Cured mutton ....do....	256,032	16,410	63,392	5,655	147,616	15,806
Total		17,319,119		18,062,740		16,419,567

Product.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cattle ....number..					27,817	$2,217,523
Sheep ....do....					82,941	653,274
Fresh beef ....pounds..	86,456,048	$5,928,594	103,459,776	$8,388,152	129,047,632	9,994,180
Cured beef ....do....	3,372,208	313,709	5,232,304	981,018		
Fresh mutton ....do....	142,425,248	9,492,590	151,480,112	11,061,685	166,406,240	12,672,030
Cured mutton ....do....	77,168	8,595	19,376	2,000		
Total		15,743,488		20,432,855		25,537,007

There were no imports of cattle and sheep into the United Kingdom from Argentina in 1901 and 1902, owing to the presence of foot-and-mouth disease in the latter country. The figures shown for 1903 cover a period of three months only, when British ports were open to Argentine live stock. The very great increase in the imports, in frozen condition, of fresh beef and fresh mutton, is stated in England to be due to the fact that live animals had been shut out during a part of the year 1900 and all of the years 1901 and 1902. The figures appear to sustain this view; for the fresh mutton imported in 1900 amounted to 37,107,840 pounds whereas in 1901 the quantity reached 142,425,248 pounds, then up to 151,480,112 pounds in 1902, and then to the still higher figure of 166,406,240 pounds in 1903. The imports of fresh beef also increased enormously. The quantity imported in 1900 was 46,173,344 pounds; in 1901, 86,456,048 pounds; in 1902, 103,459,776 pounds; and in 1903, 129,047,632 pounds.

Argentina is gaining much prominence because of her rapid increase of her export of animals and animal products, and because of this fact a few remarks on the history of this growth are in order.

FACTORIES FOR SALTING BEEF.

Factories for salting beef were first established in Argentina early in the last century. They are known as "saladeros." Previous to their establishment "boiled down" animals, hides, and tallow were the only exportable animal products. The number of saladeros have increased till in 1901 there were fifteen of them. The product of these saladeros is called tasajo, or jerked beef. The kind of cattle used in the manufacture of tasajo are from three to four years old and weigh from 750 to 950 pounds. They are principally of the criollo, or native breed, and, while steers and cows are used indiscriminately, the product from cows is considered somewhat better than that from the steers. Fat cattle are not used to a great extent, but rather cows, lean oxen, and steers[a].

The quantity of tasajo made in Argentina during four recent years, as compared with the total manufacture of Uruguay and Brazil (Rio Grande), is shown in the following table, which was published in the Argentine Yearbook for 1902, by Ronaldo Tidblom, who is the chief of the National Department of Agriculture and Live Stock Industry.

Production of tasajo for the calendar years 1898 to 1901.

Country.	1898.	1899.	1900.	1901.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Argentina	340,100	315,400	329,400	403,000
Uruguay	673,000	828,200	747,700	684,600
Brazil (Rio Grande)	340,000	270,000	232,000	210,000
Total	1,353,100	1,413,600	1,309,100	1,297,600

[a] The method of making tasajo is given in the Sixteenth Annual Report of the Bureau of Animal Industry, p. 399.

Señor Tidblom also states that from 100,000 to 250,000 Argentine steers are used annually in the saladeros of Uruguay and Rio Grande (Brazil).

The exports of tasajo for a series of years are shown in the following table:

Exports of tasajo from Argentina for the calendar years 1889 to 1898.

Year.	Metric tons.	Value in gold.	Year.	Metric tons.	Value in golds.
1889	38,304	$6,139,875	1894	42,838	4,564,447
1890	43,479	3,913,304	1895	55,089	4,225,419
1891	49,633	3,566,854	1896	45,907	3,217,541
1892	44,696	4,100,488	1897	36,238	2,446,315
1893	41,116	4,115,134	1898	22,242	2,116,458

The principal part of these exports go to Cuba, Brazil, and Uruguay, as will be observed by the next table:

Exports of tasajo to Cuba, Brazil, and Uruguay for the calendar years 1889 to 1898.

Year.	Cuba.	Brazil.	Uruguay.
	Tons.	*Tons.*	*Tons.*
1889	8,779	21,797	2,530
1890	10,800	22,000	3,398
1891	13,460	19,982	3,069
1892	12,718	22,530	4,049
1893	8,931	19,152	4,242
1894	11,619	22,271	2,538
1895	12,191	31,429	1,641
1896	3,250	32,273	558
1897	....	24,970	965
1898	....	14,369	597

The following paragraph concerning the making of tasajo at this time is from Frank W. Bicknell,[a] special agent and agricultural explorer of this Department:

The saladeros are showing rapid falling off in their production of tasajo, or jerked beef, because they can not sell their product at a price that will warrant paying the prices for animals in competition with the frigorificos, the beef extract factories, the export trade, or even the city market. One great factory has been gradually made over from a jerked-meat establishment into one for the manufacture of beef extract, for which a better quality of meat is used, while only the parts undesirable for beef extract are used for tasajo.

An examination of the preceding table shows that this article of diet is consumed in those countries where a regular supply of fresh meat can not be had, owing to the high temperature. Tasajo is not the most

[a] The Animal Industry of Argentina, Bul. No. 48, Bureau of Animal Industry, pp. 72, pls. 15, 1903.

desirable meat product, but it has no substitute in the tropical climates. It is not at all likely that it will ever become either an import or an export product of this country.

FACTORIES FOR FREEZING MEAT.

The first factory for freezing meat was established at Campaña in Buenos Aires in 1883, and a second one at Barracas, Buenos Aires, in 1884, and still a third one at Zarate, Buenos Aires, in 1886. Señor Tidblom states (in 1902) that these three establishments have handled all of the frozen meat trade of Argentina. He says:

From the year 1883, when 17,165 frozen sheep were exported, until 1901, the meat exported has increased steadily; and 1901 saw a higher export than in any preceding year, about 100,000 tons of frozen meat having been shipped. This represented about 46 per cent of the frozen meat imported into Great Britain. the remainder having been shipped from Australia and New Zealand.

POSSIBILITIES OF EXTENSION OF LIVE-STOCK RAISING.

It can not be denied that Argentina's capacity for extending her live-stock raising is very great, and that country confidently expects still further to increase her exports to the United Kingdom. Mr. Bicknell,[a] who spent about two years investigating agricultural conditions in Argentina, quotes portions of a circular that was published by Mr. Daniel Kingsland, which was distributed to cattle raisers. As these extracts have a direct bearing upon the kind of animals that are exported from Argentina, they are given herewith:

Mr. Daniel Kingsland, manager of the new chilled-meat works in La Plata, near Buenos Aires, has just issued a circular to estancieros giving them advice as to the best kind of animals to meet the demands of the chilled-meat trade. His suggestions have added importance from the fact that he is an old resident of the country, a producer of beef animals himself, and knows the conditions and possibilties of the country well. In his circular he says:

"With regard to cattle, the export of beef in a refrigerated or chilled state to the United Kingdom is now an accomplished fact, but is still in its infancy, and places this country in the position of being the principal competitor of the United States of North America, which has hitherto enjoyed the whole of this trade. To compete with them successfully it is our opinion that great care should be taken to produce bullocks which will always be worth more for this purpose and command a higher price than for any other. For chilling it is not necessary to send extremely heavy-weight cattle. Bullocks of two and a half to three years old, well finished, and weighing from 550 to 620 kilos, or an average weight of 580 kilos (1,213 to 1,367 pounds, or an average of 1,278 pounds), will command the best prices. To produce this article from the average well-bred mestizo (graded animal), now plentiful, it does not matter whether the cross is Durham, Polled Angus, Hereford, Red Lincoln, or any other meat-producing strain, so long as the animals are always well fed and looked after in the winter season when grass is scarce, or any other time when there should be a shortage of feed, never allowing the animals to become poor. This can de done by always growing a certain amount of alfalfa, corn, or other foods for winter

[a] Bul. No. 48, The Animal Industry of Argentina, p. 56.

feeding. By doing this estancieros will have no difficulty in producing the animals required all the year around, and the results will be satisfactory to themselves. The trouble and expense of cultivating a small proportion of their land in order to provide food for the winter and fattening stock in bad seasons will be well repaid."

Concerning the production of lambs for export, Mr. Kingsland says:

"The production of lambs for export shows the greatest room for improvement, and should give good results to those who undertake to produce the suitable article. This can be done by introducing meat-producing strains of sheep into your flocks, such as Hampshire, Southdown, Oxford, Shropshire, and also Border Leicester rams, and, for the low camps, Romney Marsh rams. Then by winter feeding the ewes, enabling them always to have plenty of milk for their lambs, they would fatten at from five to seven months old to average 30 kilos (66 pounds) live weight, and would be worth 10s., or even more. Lambs intended for export should never be shorn, as it throws them back, and the wool obtained barely covers the cost of shearing. By producing lambs and selling them at this age you are turning your capital every year, and therefore doubling your producing powers. The following facts will show you how far we are behind New Zealand, which country is our chief competitor in the frozen-sheep industry: The total number of sheep of all classes in New Zealand last year was about 20,000,000, and it exported nearly 4,000,000 of frozen sheep and lambs. At the same time we had 100,000,000 sheep in this country and our export was only 3,500,000. These figures speak for themselves, and should be an object lesson as to the possibilities in the production and early maturing of fat lambs; and it has also had the effect of increasing the value of, and extending the demand for, land suitable for the production of lambs to a very great extent. We would strongly advise estancieros to lay themselves out to prepare a certain number of lambs for export every year. The results must be of the most satisfactory nature to them and will increase the value of the flocks and camps all around."

IMPORTS AND EXPORTS OF ANIMALS AND ANIMAL PRODUCTS.

By John Roberts,
Editorial Clerk, Bureau of Animal Industry.

The official report of the Bureau of Statistics, Department of Commerce and Labor, states that the value of our domestic exports of all kinds for the calendar year 1903 was $1,457,575,865, this being an increase of rather more than $120,000,000 over the total of the previous year; but the last-mentioned year (1902) showed a deficit of quite $100,000,000 when compared with 1901. It can therefore be seen that the increased activity in our foreign commerce last year resulted in recovering the big loss of 1902, with a little besides. An examination of the totals of the respective divisions of the exports of 1903 shows that fully two-thirds of the whole were agricultural and forest products, and about one-sixth was animals and animal products, such as come under the cognizance of this Bureau.

The total value of the last-named exports (animals and animal products) for 1903 was $255,304,625; the total for 1902 was $244,886,259: there was therefore an advance last year of $10,418,366. However, it must be remembered that 1902 was the lean year of recent times, because of the great scarcity of the meat supply at that time, and a glance at the statement below, showing the gain or loss in this branch of our trade from year to year, will show that the decrease of 1902 was no less than $41,939,893, and that for the four years prior to 1902 there had been a succession of increases averaging close upon $20,000,000 per year. It would thus appear that last year's gain was not as satisfactory as might have been expected, which fact may be taken as evidence of the difficulty of getting trade back after once losing it.

Turning to the imports, we find that our purchases of animals and animal products in 1903 amounted to $101,007,543, a slightly smaller total than that of the year before, which was $102,907,186. When these figures are compared with the previously mentioned totals of the exports it will be seen that the balance of trade in favor of the United States for these products is a very substantial one. The excess of the exports over the imports in 1903 was $154,297,082; that of 1902 was considerably less—$141,979,073.

EXPORTS.

The following statement shows the total annual value of our exports of animals and animal products for the years 1892 to 1903, inclusive, together with the gain or loss over the previous year.

Annual value of exports of animals and animal products, 1892 to 1903.

Year.	Value of exports.	Gain (+) or loss (−).	Year.	Value of exports.	Gain (+) or loss (−).
1892	$222,666,575		1898	$233,450,480	+$23,221,034
1893	194,145,502	−$28,521,073	1899	250,099,826	+ 16,649,340
1894	212,754,589	+ 18,609,087	1900	264,316,945	+ 14,217,119
1895	216,272,730	+ 3,518,141	1901	286,826,152	+ 22,509,207
1896	213,263,615	− 3,009,115	1902	244,886,259	− 41,939,893
1897	210,229,446	− 3,034,169	1903	255,304,625	+ 10,418,366

Referring to the detailed list of exports which follows next, attention is called to a few of the articles therein, the totals of which have changed conspicuously from those of the previous year. The most striking feature in the whole list was the heavy increase in the shipments of live cattle; the number sent abroad last year was 519,963, while that of 1902 was 327,118, or fewer by 192,845 animals. The total values of these cattle were $24,301,969 in 1902 and $37,725,452 in 1903. On the other hand, the exports of horses fell off almost one-half, and the unusually large shipments of mules which had prevailed since 1899 collapsed utterly. The cause for this will be explained later, under "Imports and exports of farm animals." There was also an unaccountably large decrease in bacon, and hams fell off, too, but to a much less extent. The shipments of bacon in 1902 amounted to 270,141,141 pounds, with a value of $27,101,431, while those of last year totaled only 213,519,817 pounds, valued at $21,800,532. Oleo oil increased sharply, as did also grease and other soap stock, also tallow; but canned beef declined from 81,362,981 pounds to 66,738,931 pounds. There were no unusual changes in the other items, and all the important articles will be dealt with separately later on.

The quantities and values of the domestic exports of animal origin for the calendar year 1903 were as follows:

Quantities and values of animals and animal products exported from the United States in the calendar year 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Article.	Quantity.	Value.
Animals:		
Cattle ... number..	519,963	$37,725,452
Hogs ... do....	5,823	53,180
Horses ... do....	39,367	3,142,731
Mules ... do....	3,101	354,776
Sheep ... do....	189,872	1,153,770
All other, including fowls		121,265
Bones, hoofs, horns, etc		178,392
Dairy products:		
Butter ... pounds..	9,345,416	1,600,323
Cheese ... do....	19,634,239	2,302,118
Milk		1,018,063
Eggs ... dozens..	1,456,342	316,211
Feathers		129,960

Quantities and values of animals and animal products exported, etc.—Continued.

Article.	Quantity.	Value.
Glue ....pounds..	2,710,203	$265,799
Grease, and other soap stock	....	3,495,418
Hair, and manufactures of	....	680,832
Hides and skins (other than furs) ....pounds..	21,251,307	2,078,414
Lard oil ....gallons..	327,944	251,963
Other animal oil ....do....	202,691	148,712
Leather:		
Sole leather ....pounds..	33,501,774	6,320,663
Upper leather	....	16,343,309
Other leather	....	1,033,437
Meat products:		
Beef—		
Canned ....pounds..	66,738,931	6,850,079
Fresh ....do....	293,401,843	26,692,858
salted, pickled, and cured ....do....	58,154,546	3,703,177
Tallow ....do....	63,537,840	3,320,080
Bacon ....do....	213,519,817	21,800,532
Hams ....do....	205,494,949	24,383,662
Pork—		
Canned ....do....	10,817,461	1,127,495
Fresh ....do....	20,900,694	1,962,557
Salted and pickled ....do....	107,082,084	10,367,223
Lard ....do....	535,375,757	50,224,669
Lard compounds and substitutes ....do....	52,984,214	3,920,268
Mutton ....do....	2,780,265	253,384
Poultry and game	....	1,138,816
Sausage and sausage meat ....pounds..	5,262,081	586,384
Sausage casings	....	2,220,126
All other meat products	....	4,215,131
Oleo oil ....pounds..	152,100,830	13,032,189
Oleomargarine ....do....	7,391,199	747,860
Wool, raw ....do....	383,965	43,347
Total	....	255,304,625

IMPORTS.

There were few changes of any moment in the imports of animal products for 1903; indeed, there were only two that were of any consequence, namely, a decline of $3,382,579 in hides of cattle, and an advance of $3,221,507 in wool; the one total, it may be observed, closely offsetting the other. There were a number of small decreases in several of the other items which brought the total value for the year to $101,007,543 as against $102,907,186 for 1902. There was a general decrease in the importations of live animals, but this was not marked in any case except cattle. Our imports of cattle for market purposes have visibly declined for two years past, as may be seen by referring to the accompanying table, and cattle for breeding purposes were purchased in far less numbers last year than in any of the other years on the list. The imports of cheese continue to be slightly greater year by year; those of 1903 amounted to 21,531,691 pounds and were valued at $3,252,653. The figures for crude feathers show that there was a much

increased demand last year when compared with the year before, as the total value of the imports went from $1,916,125 to $2,888,061. The imports of grease and oils fell off slightly, as did also those of hide cuttings and other glue stock, but our manufacturers have required an increasing quantity of hair since 1901; the total value of this product imported last year reached $2,505,612.

A perusal of the table will show that the only really large sums thereon are confined to two classes of products—hides and skins (other than furs) and wool, these being the only important items wherein the domestic supply is insufficient for the needs of our manufacturers. A detailed account of these branches of trade, among others, will be found farther on in separate chapters.

The following is a comparative statement of the total annual value of each article of animal origin imported during the past four years:

Table showing the value of animals and animal products imported into the United States for the calendar years 1900 to 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Article imported.	1900.	1901.	1902.	1903.
Cattle	$1,588,616	$1,626,964	$1,218,412	$553,029
For breeding	282,930	315,641	350,901	91,740
Horses	242,595	296,933	303,975	386,289
For breeding	644,216	969,776	1,441,893	1,086,131
Sheep	1,214,912	940,325	1,006,186	831,587
For breeding	45,220	49,974	43,045	21,826
All other animals, including fowls	138,649	119,304	314,150	381,668
For breeding	192,416	260,671	308,795	332,819
Bones, hoofs, horns, etc	806,755	670,171	701,133	548,385
Bone and horn manufactures	224,970	220,820	235,366	268,410
Bristles	1,995,289	1,666,747	2,458,481	2,496,492
Dairy products:				
Butter	14,135	28,759	95,571	39,399
Cheese	1,948,033	2,335,829	2,862,677	3,252,653
Milk	47,996	36,897	24,459	60,705
Eggs	7,862	12,041	52,547	21,850
Feathers, crude	1,397,334	2,001,498	1,916,125	2,888,061
Glue	491,190	449,769	559,415	596,426
Grease and oils	678,635	888,018	1,038,611	847,929
Hair	1,835,439	1,796,138	2,383,327	2,505,612
Hides and skins (other than furs):				
Goatskins	19,008,097	25,265,670	24,171,569	23,441,687
Hides of cattle	18,315,739	16,001,902	16,871,656	13,489,077
All other	14,264,157	14,297,816	16,689,172	16,350,180
Hide cuttings and other glue stock	1,186,627	826,206	786,396	750,798
Leather:				
Sole leather, calfskins, etc	140,338	176,258	607,734	955,837
Skins for morocco	2,940,949	2,399,603	2,037,556	2,030,389
Upper leather	3,115,400	2,931,516	2,406,071	2,150,179
Meat products	452,669	474,232	1,513,705	897,396
Sausage casings	738,529	583,495	918,031	919,255
Wool	19,210,062	14,017,432	19,590,227	22,811,734
Total	93,169,750	91,660,405	102,907,186	101,007,543

IMPORTS AND EXPORTS OF FARM ANIMALS.

CATTLE.

Imports.—There were 40,027 foreign cattle brought into the United States during 1903. Of these, 694 were high-class breeding stock and 39,333 inferior animals—feeders—brought in from Mexico and Canada to be prepared for the market. The above numbers represent a great falling off as compared with 1902, when the breeding animals numbered 2,119 and the others 91,362. As regards values, the breeding stock imported last year were purchased at a considerably less average price than those of the year before, which, in turn, were cheaper than those of 1901 by a still greater margin; denoting a trend toward the acquisition of useful rather than fancy stock. On the other hand, the prices of the range animals have tended in the opposite direction, as may be seen by the following averages of the two classes for three years past:

Average price per head of imports of cattle, 1901 to 1903.

Year.	Cattle for breeding.	Other cattle.
1901	$221.50	$12.12
1902	165.50	13.34
1903	132.25	14.06

Exports.—Our export cattle trade received a very strong impetus last year, 519,963 animals having been shipped abroad against 327,118 in 1902, or an increase of 192,845. Of course, it can be seen at once by a glance at the list below that 1902 was the year of scarcity in the cattle business, but the total of 1903, considerably greater as it is than any of the other annual totals on the list, is quite remarkable notwithstanding. The great majority of these export cattle go to supply the English market, 342,745 of last year's total having been destined for that purpose. Nearly all the remainder were sent to the West Indies and Canada, the former taking 97,020 and the later 50,959. The average value of the exports of cattle was slightly less last year than in 1902, while the price in the latter year was much below that of 1901. The averages for the years in question were $80.50 per head in 1901, $74.25 in 1902, and $72.50 last year.

HOGS.

Imports.—So few hogs are imported that no separate entry is made of them.

Exports.—A glance at the table will show that whereas considerable numbers of hogs were exported annually from 1896 to 1901, the pronounced scarcity of the past two years has brought the output to a

very low point, but it may be remarked that 1,241 more were sent abroad last year than in 1902. No live hogs are sent to the English market. Practically all our exports go the West Indies and over the Canadian and Mexican borders.

SHEEP.

Imports.—Considerably fewer sheep were imported last year than in 1902, the remark applying to both sheep for breeding and those for market purposes. The former decreased from 2,026 to 1,106, and the latter from 302,729 to 247,276. The average values per head of the two classes for the past three years were as follows:

Average price per head of imports of sheep, 1901 to 1903.

Year.	Sheep for breeding.	Other sheep.
1901	$23.08	$3.56
1902	21.25	3.32
1903	19.73	3.36

Exports.—The export column shows an unusally heavy shipping trade in 1901; this was followed by a marked decline in 1902, and there was no recovery last year. The respective totals for the years mentioned were 432,419 for 1901, 235,497 for 1902, and 189,872 for last year. However, the shipments for 1901 and 1902 were much larger than the average, and the number sent out last year yet compares favorably with several of the years prior to 1901. As regards values the high prices of 1902 receded in some degree, but not to the level of 1901; the average price per head of the sheep exported in the last-named year was $5.82, that of 1902 was $6.34, and that of last year $6.08. About two-thirds of our sheep exports are sent over to Great Britain, and most of the remainder go to British North America; small numbers are taken by Belgium, Mexico, and the West Indies.

HORSES.

Imports.—The majority of our imports of horses are for breeding purposes. The latter are supplied by France, Canada, and the United Kingdom. The total number of this class imported in 1903 was 2,631, of which France contributed 993, British North America 587, and the United Kingdom 550. The importation of breeding stock in 1902 was considerably greater, namely, 3,294, while that of 1901 was smaller than both, totaling 2,452. Of the working animals, which practically all come in over the Canadian border, there were 2,196 imported last year, this number being an increase of about 10 per cent over the two previous years. The accompanying table shows the annual average values of the imports of horses for the past three years. It will be

noticed that in conformity with the rule, as evidenced by all the other classes of breeding animals, there was a slight fall in the cost of horses for breeding in 1903, but there was a remarkable rise in the average of the working animals for that year.

Average cost per head of imports of horses, 1901 to 1903.

Year.	Horses for breeding.	Working horses.
1901	$395.50	$152.25
1902	437.75	155.50
1903	412.75	176.00

Exports.—The decline in the exports of horses in 1903 was wholly due to the discontinuance of the shipments to South Africa consequent upon the Boer war. The importance of this trade while it lasted may be judged from the annual shipments to British Africa since 1900, the year it was inaugurated; they were as follows: In 1900, 23,242; in 1901, 59,096; in 1902, 25,955; in 1903, 46. These, however, were not all, as a large number went indirectly as well. British North America was the chief market for our horses last year, the number sent there having been 28,578 out of the total exports of 39,367. The West Indies, United Kingdom, and Mexico took most of the remainder. The slackness of the demand brought prices down 20 per cent in 1903, the average value per head of the exports last year having been $80, against $100.25 in 1902 and $100.50 in 1901. This, however, should not be taken to mean that prices of horses have fallen in the markets of the United States, because the reverse is true, as may be seen by referring to the range of prices of horses at Chicago and Omaha on page 681 of this volume.

MULES.

Imports.—Imports of mules, if any, are not given separately.

Exports.—The extraordinarily heavy shipments of 1899 to 1902, inclusive, were caused by the South African demand, as was the case with horses, previously mentioned. The total cessation of this demand last year disturbed the equilibrium of the trade to such an extent that the exports of mules in 1903 went far below the normal. Contrary to horses, however, values continued on the rise, in which connection it is tentatively suggested that this may be merely a case of the survival of the fittest, so many mules having left the country in recent years that only good ones remain. Be that as it may, the returns show that average values of the exports increased $16.50 per head in 1902 and an additional $7.50 last year, the full averages having been $90.50 in 1901, $107 in 1902, and $114.50 in 1903.

The appended tables present (1) the imports and exports of the different farm animals annually from 1896 to 1903 and (2) the exports of the same for 1903 by countries.

Number and value of imports and exports of farm animals for the years 1896 to 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Year.	Cattle.		Hogs.		Sheep.		Horses.		Mules.	
	Number.	Value.	Number	Value.	Number.	Value.	Number.	Value.	Number.	Value.
IMPORTS.										
1896	141,653	$988,677	....	....	382,443	$1,013,481	8,252	$509,819	....	....
1897	403,717	3,581,643	....	....	414,455	1,145,922	5,993	505,838	....	....
1898	261,826	2,730,882	....	....	360,820	1,187,210	2,718	321,835	....	....
1899	186,596	2,235,383	....	....	361,731	1,305,063	3,215	581,928	....	....
1900	142,055	1,871,546	....	....	345,985	1,260,132	3,541	886,811	....	....
1901	135,694	1,942,605	....	....	265,952	990,299	4,402	1,266,709	....	....
1902	93,481	1,569,313	....	....	304,755	1,049,231	5,248	1,745,868	....	....
1903	40,027	644,769	....	....	248,382	853,413	4,827	1,472,420	....	....
EXPORTS.										
1896	394,772	36,576,412	33,785	$367,917	323,576	1,948,841	28,632	3,601,137	6,534	$475,106
1897	447,469	39,379,532	16,841	150,814	218,427	1,331,712	45,642	5,617,265	7,753	631,904
1898	397,879	33,463,267	16,879	117,546	176,498	1,070,966	48,917	6,010,773	6,996	514,569
1899	409,176	30,685,461	52,230	363,609	150,824	861,337	49,983	5,747,468	20,228	1,702,099
1900	423,181	33,819,164	33,915	313,836	148,391	900,734	79,520	9,102,432	50,179	4,757,892
1901	454,590	36,606,204	15,909	169,097	432,419	2,514,766	99,809	10,037,204	25,053	2,267,262
1902	327,118	24,301,969	4,582	47,186	235,497	1,492,484	60,694	6,086,012	16,306	1,744,192
1903	519,963	37,725,452	5,823	53,180	189,872	1,153,770	39,367	3,142,731	3,101	354,776

Number and value of exports of farm animals for the calendar year 1903 and countries to which exported.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Country to which exported.	Number.	Value.
Cattle:		
United Kingdom	342,745	$32,443,133
Belgium	12,774	1,257,313
British North America	50,959	1,908,451
Central American States and British Honduras	16	1,287
Mexico	4,426	247,056
West Indies and Bermuda	97,020	1,586,021
South America	383	32,487
Asia and Oceania	62	4,750
Other countries	11,578	244,954
Total	519,963	37,725,452
Hogs:		
British North America	1,851	14,114
Mexico	895	8,820
West Indies and Bermuda	1,329	15,920
South America	24	469
Asia and Oceania	4	100
Other countries	1,720	13,757
Total	5,823	53,180

Number and value of exports of farm animals for the calendar year, 1903, etc.—Cont'd.

Country to which exported.	Number.	Value.
Sheep:		
United Kingdom	117,357	$856,921
Belgium	4,471	37,745
Other Europe	2	25
British North America	58,442	181,671
Mexico	3,282	19,982
West Indies and Bermuda	5,256	35,779
South America	909	6,861
Other countries	153	14,786
Total	189,872	1,153,770
Horses:		
United Kingdom	2,929	495,630
Belgium	42	8,591
Germany	185	27,853
Other Europe	19	2,350
British North America	28,578	2,218,161
Central American States and British Honduras	9	1,340
Mexico	1,940	124,969
West Indies and Bermuda	5,509	225,135
South America	60	6,422
Other Asia and Oceania	50	20,650
British Africa	46	11,630
Total	39,367	3,142,731
Mules	3,101	354,776
All other animals, including fowls		121,265
Total animals		42,551,174

EXPORTS OF ANIMAL PRODUCTS TO THE UNITED KINGDOM.

Considerably more than one-half of our entire exports of animals and animal products goes annually to the United Kingdom. The proportion in 1903 was, perhaps, rather less than the average, Great Britain's share in that year amounting in value to $154,028,012, out of our total exports of $266,333,734. The annual totals (since 1898) of our trade with Great Britain in these products, given below, show there was a steady increase all along until 1902. This was the year when a serious shortage occurred in our meat supply, and, inasmuch as the greater part of the trade is composed of meats and animals for slaughter, there was bound to be a big reduction in consequence. Some improvement was manifested last year, but it was only slight. The total values of our exports of animals and animal products to the United Kingdom for the past six years were as follows:

1898	$148,690,753
1899	154,845,165
1900	162,726,994
1901	179,550,536
1902	149,523,438
1903	151,817,478

Fig. 1.—Lady Holmes and Dick, Jr., Sweepstakes Champion Angora Goats, 1903.

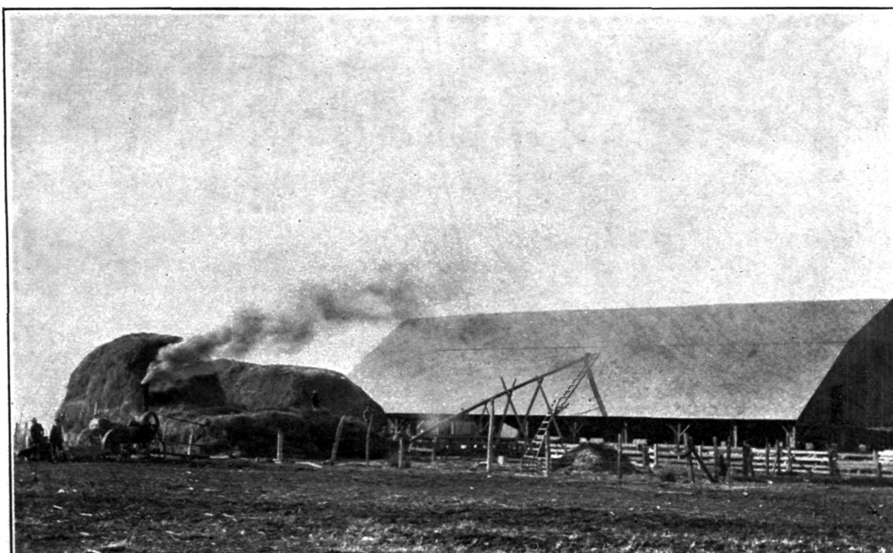

Fig. 2.—Delivering Chopped Alfalfa into a Barn by Pipe.

It will be seen that, whereas there was in 1902 a decline of $30,027,098, the advance last year over 1902 was only $2,294,040. A glance down the itemized table below, which shows a comparison between 1902 and 1903, will place the chief responsibility for this poor recovery on one item—bacon. The table shows a remarkable decline in the export of this product last year, the total being 163,894,472 pounds, valued at $16,892,518, as against 218,785,008 pounds, valued at $22,079,353, in 1902. There can be little doubt that this falling off was caused mainly, if not wholly, by two things—the increase in the home consumption and the continued scarcity of the market supply. The first of these factors was largely due to the settling of the retail prices, thereby bringing the domestic consumption back to the normal. The second, the continuance of the short supply, was probably not so well known. It was, nevertheless, undoubtedly true that the scarce supply of 1902 was duplicated last year; in fact, there were, if anything, fewer hogs marketed last year than in 1902. This is borne out by the reports of the various stockyards companies and by our records of the receipts and shipments of live stock throughout the country. The latter are given in another part of this volume, under "The movement of live stock." It will there be seen that the numbers of hogs marketed in 1902 and 1903 were practically equal, and that they were in both cases about 4,000,000 fewer than the number for 1901.

However, the decrease in hog products was more than compensated by beef products. There was a striking increase in the cattle trade, the total value going from $21,943,345 in 1902 to $32,443,133 last year, an increase of over $10,000,000. Canned beef dropped a little, but fresh beef increased almost $2,000,000. The other items of the table show but little variation, some having slight increases and others similar decreases; there was, however, a sharp decline in horses, and a large increase in tallow.

The detailed exports to the United Kingdom for 1902 and 1903, in comparative form, were as follows:

Quantity and value of animals and animal products purchased by the United Kingdom from the United States in the calendar years 1902 and 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Article.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Number.	*Dollars.*	*Number.*	*Dollars.*
Cattle	229,681	21,943,345	342,745	32,443,133
Horses	6,455	1,127,050	2,929	495,630
Sheep	175,726	1,248,365	117,357	856,921
	Pounds.		*Pounds.*	
Bacon	218,785,008	22,079,353	163,894,472	16,892,518
Beef—				
Fresh	238,807,914	24,692,148	291,790,863	26,544,184
Canned	57,093,654	5,803,272	48,822,078	5,011,789
All other	16,919,961	1,305,779	20,654,633	1,395,339

Quantity and value of animals and animal products purchased, etc.—Continued.

Article.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
Butter	4,424,932	837,382	4,020,418	676,328
Cheese	16,990,776	1,833,323	17,855,068	2,052,206
Hams	199,744,745	23,362,282	177,745,090	21,193,635
Hides and skins (other than furs)	342,405	36,212	3,298,943	321,218
Lard	198,718,040	20,419,131	198,456,816	18,812,984
Leather—				
Sole	32,491,406	5,716,988	27,914,399	5,098,254
Upper and all other		10,467,906		11,072,694
Oleo oil and oleomargarine	6,808,949	667,956	6,602,645	563,866
Pork, fresh and salt	80,075,544	7,667,471	71,432,291	7,215,877
Tallow	5,252,576	315,475	23,214,137	1,170,902
Total		149,523,438		151,817,478

IMPORTS OF ANIMAL PRODUCTS INTO THE UNITED KINGDOM.

In view of the fact that the United Kingdom, as is well known, is the great purchaser of food products and raw materials among the nations, it may be interesting to show the total imports of animal products into that country, together with the principal sources of supply, more especially the amount contributed by the different parts of the American continent. These are set forth in the following table, which gives the quantities and values of this class of products that were consumed or converted into manufactures within the United Kingdom during the year 1903, transit trade not being taken account of. The total foots up to the large sum of $660,952,170; that for 1902 was $631,833,325; thus there was an increase last year of $29,118,845.

Parallel with the total values are set out the portions severally contributed by the United States, Canada, and Argentina, the two last-named countries being our chief competitors on the American continent. The figures are taken from the British official returns, and it may be said they are in some instances widely at variance with the United States figures, but, whatever their degree of accuracy, they are the best available for the purpose of this comparison. The amounts as given are probably somewhat unfavorable to Canada, because it is known that during some of the winter months, owing to the northern ports being closed, a considerable quantity of Canadian produce is shipped from United States ports, and is thus credited to us. This is partly offset, however, by a limited amount of our products which finds an outlet through Canadian ports in summer.

It will be seen from the respective totals that an important share of the trade of supplying the British with animal products is in our hands; nevertheless, a few of the items are conspicuously adverse to us, and it may be well to notice these in detail. The first item of this nature

to catch the eye is fresh mutton. It should be noticed in the first place that almost as much mutton is imported into Great Britain as beef. The list shows the total receipts of mutton last year to have been 449,861,664 pounds, valued at $38,085,531, while those for beef were 465,875,872 pounds, valued at $40,713,825. One-half of the total mutton was supplied by New Zealand, and the greater part of the remainder by Argentina. These two countries between them furnished nearly nine-tenths of the whole. The amount contributed by the United States was too small to mention, which indicates that we have no surplus and that there is therefore room for enlargement in our production.

In regard to bacon it will be seen that we supplied rather more than half the total, but it is probable that the amount attributed to us should have been somewhat smaller and that to Canada larger because of the movement, before alluded to, of Canadian produce through United States ports in winter. This view seems to be confirmed by the official returns, inasmuch as the figures given in the Canadian reports show that rather more than twice the amount of bacon was exported from the Dominion to the United Kingdom than is credited to Canada in the British returns. However, our most important competitor in the English bacon trade is Denmark. The amount of Danish bacon received in Great Britain in 1903 was 167,563,312 pounds, valued at $20,896,834. This is very much less than our total, but it should be especially noted that the Danish product excels ours in one important particular—quality. United States bacon sent over in 1903 averaged 11 cents per pound, while Danish averaged 12½ cents. These figures are, however, very encouraging when compared with those of a few years back, as the Danish product had for a long period brought as high as 4 cents per pound more than ours. Last year's average, therefore, denotes that we have made substantial progress as regards the quality of our product.

We provided less than one-hundredth part of the butter imported into England last year, the total of which reached the enormous amount of 454,796,608 pounds, of the value of $101,216,903. Canada was considerably ahead of us, with a contribution valued at $4,215,601. It is worthy of remark, in passing, that a small country like Denmark provided, in round figures, no less than $50,000,000 worth of this butter—almost one-half of the total.

Cheese is another article which the table shows in the Canadian exports far greater than ours. The cheese trade of the Dominion is, judging from the figures, a very important one, as more than two-thirds of the entire imports into Great Britain last year came from Canada.

Of the large total of upward of $100,000,000 worth of wool, mohair, etc., purchased by the United Kingdom in 1903, none was furnished by us. We, in fact, do not begin to supply our own needs in these

necessary articles of commerce. Argentina contributed wool to the value of $5,445,589, or nearly 5½ per cent of the total.

The table also shows that, whereas considerable amounts of condensed milk and of hides were received, our share in the trade was insignificant.

Imports of animals and animal products into the United Kingdom in 1903.

Article.	Quantity.	Value.	Amount contributed by—		
			United States.	Canada.	Argentina.
Cattle ....number..	522,546	$44,816,192	$26,275,416	$16,136,224	$2,217,523
Sheep and lambs ....do....	354,241	2,657,416	1,286,780	627,997	653,274
Horses ....do....	27,266	3,072,071	583,742	71,246	....
Beef:					
Fresh ....pounds..	465,875,872	40,713,825	27,932,493	....	9,993,888
Salt ....do....	19,453,504	1,195,236	1,130,554	....	....
Mutton, fresh ....do....	449,861,664	38,085,531	....	....	12,672,030
Pork:					
Fresh ....do....	79,054,528	7,569,607	1,555,499	....	....
Salt ....do....	26,609,296	1,553,698	770,453	....	....
Bacon ....do....	577,582,656	66,277,545	35,870,620	8,232,595	....
Hams ....do....	127,829,184	15,293,336	12,665,817	2,552,684	....
Rabbits, dead ....do....	53,272,240	3,522,767	....	....	....
Poultry and game	....	5,854,818	....	....	....
Meat, pickled, etc ....pounds..	85,966,384	11,853,947	(a)	....	....
All other meat ....do....	74,285,232	5,869,739	1,380,947	....	....
Butter ....do....	454,796,608	101,216,903	927,934	4,215,601	....
Cheese ....do....	301,751,968	34,329,775	4,638,821	23,471,567	....
Milk, condensed ....do....	92,920,464	8,463,223	(a)	....	....
Eggs ....dozens..	198,488,970	32,204,643	....	1,063,676	....
Lard ....pounds..	194,064,080	18,837,487	17,291,784	....	....
Tallow and stearin ......do....	156,259,488	9,674,042	1,735,919	....	2,038,611
Margarine ....do....	98,917,616	11,272,537	....	....	....
Hides:					
Raw, dry ....do....	32,640,160	4,269,687	....	....	....
Raw, wet ....do....	55,303,472	5,989,411	....	....	[b] 184,981
Goatskins, undressed.number..	13,246,578	6,141,328	(a)	....	....
Sheepskins, undressed...do....	17,084,812	8,452,162	(a)	....	....
Bristles ....pounds..	4,869,809	2,926,737	(a)	....	....
Bone manure ....do....	118,711,040	1,132,386	(a)	....	....
Glue, etc ....do....	26,052,880	2,280,384	(a)	....	....
Leather ....do....	125,937,168	39,371,537	16,498,802	....	....
Wool, sheep's ....do....	599,509,732	100,359,508	....	....	[c] 5,445,589
Alpaca ....do....	5,460,432	1,511,496	....	....	....
Mohair ....do....	28,068,379	8,662,988	....	....	....
Other goat's hair ....do....	3,521,807	313,510	(a)	....	....
Camel's hair ....do....	5,810,780	715,356	(a)	....	....
Shoddy, etc ....do....	71,638,597	2,995,292	(a)	....	....
Woolen yarn ....do....	24,488,472	11,496,050	(a)	....	....
Total	....	660,952,170	150,545,582	56,371,590	33,205,896

[a] Origin not stated. [b] Includes Uruguay. [c] Designated "South America, east coast."

IMPORTS OF MEAT INTO THE UNITED KINGDOM.

The London (England) Live Stock Journal publishes annually a computation of the total amount of foreign meat, live and dead,

imported into the country. The table appended is compiled from this report and gives the annual totals since 1890. The vast increase in this trade during the past ten years can be seen at a glance; the difference between the totals of 1893 and 1899, for instance, being upward of 1,000,000,000 pounds. The upward tendency of the totals received a check in 1902, caused by the scarcity of cattle that year in this country. Last year's totals show a partial recovery, but the figures were considerably below those of two years ago and even slightly below those of 1900. A perusal of the columns will show that this recovery was very slight in the case of dead meat, while the total of live meat not only equaled that of the preceding year but exceeded it. The reason for this lies in the fact that 20,397 cattle were received from Argentina during the early months of the year, whereas for upward of two years previously none at all had been received. The barriers were put up in 1900 on account of foot-and-mouth disease, and, although importations were resumed in February, 1903, they were again prohibited four months later for the same reason as before.

The quantities in the first column of the table, giving the dead weight of the live meat, are got by allowing an average dressed weight for cattle of 90 stone (720 pounds); for calves, 16 stone (128 pounds); and for sheep, 7½ stone (60 pounds):

Estimated annual totals of meat imported into United Kingdom since 1890.

Year.	Dead meat.	Dead weight of live meat.	Total meat.
	Pounds.	*Pounds.*	*Pounds.*
1890	1,127,642,768	452,368,000	1,580,010,768
1891	1,108,116,240	362,820,864	1,470,937,104
1892	1,188,059,264	366,239,776	1,554,299,040
1893	1,053,750,544	248,815,728	1,302,566,272
1894	1,200,513,440	371,314,720	1,571,828,160
1895	1,354,944,192	362,966,352	1,717,910,544
1896	1,514,026,640	451,092,656	1,965,119,296
1897	1,680,579,712	481,719,840	2,162,299,552
1898	1,841,873,040	449,444,576	2,291,317,616
1899	1,921,750,880	398,818,896	2,320,569,776
1900	2,006,114,656	379,328,432	2,385,443,088
1901	2,101,616,272	379,697,136	2,481,313,408
1902	1,900,754,464	319,474,736	2,220,229,200
1903	1,959,790,560	397,443,872	2,357,234,432

THE LONDON LIVE-STOCK MARKETS.

An annual report on the cattle and sheep markets of the English metropolis which appeared in the London Live Stock Journal enables us to present a number of interesting details relative to this subject. First is shown the arrivals of cattle for each month of the past year at the two great live-stock marts of the city—Islington and Deptford. British animals are handled at the first-named market, while

foreign stock is taken care of at Deptford. It should be stated that the totals in the British column include, besides fat cattle, butchering cows, bulls, and rough cattle, as well as Irish store cattle.

Arrivals of British and foreign cattle in London in 1903.

Month.	British.	United States.	Canadian.	Argentine.
January	7,760	7,557	....	....
February	5,610	9,049	....	133
March	6,310	8,394	897	2,298
April	4,190	11,252	....	9,450
May	4,330	11,095	522	6,998
June	4,695	15,310	3,762	1,518
July	4,140	15,310	1,668	....
August	6,100	13,863	3,169	....
September	6,205	8,651	4,518	....
October	5,870	14,524	5,621	....
November	7,080	13,026	3,641	....
December	5,920	13,655	1,453	....
Total 1903	68,210	141,686	25,251	20,397
Total 1902	81,960	108,139	34,629	....

The average top prices obtained each month for the best British and foreign cattle are shown below. The amounts as published are per stone (8 pounds)—"sinking the offal," or excluding the offal—which corresponds roughly, if not exactly, to our dressed weight. These prices have been converted so as to show the cost per 100 pounds, but it must not be forgotten that they are for dressed weight and not for live weight. The quotations are for the best animals in each class, and if we assume that the cattle in question dressed on an average 62½ pounds to 100 pounds live weight, then the amounts given in the table will be equivalent to 160 pounds live weight, and a rough comparison with United States live-weight prices may be had by dividing each amount by this figure; thus the first amount ($14.15) divided by 1.60 equals $8.84, which is the live-weight price.

Average top rates per 100 pounds (dressed weight) of British and foreign cattle in London in 1903.

Month.	British.		United States.		Canadian.		Argentine.	
January	$14.15 to	$15.66	$13.14 to	$14.90	....		....	
February	13.64	15.66	12.38	13.64	....		....	
March	13.64	14.15	13.14	13.64		$12.88	$12.38 to	$12.62
April	13.64	14.65	12.63	13.64	....		10.61	12.38
May	13.64	14.15	11.11	12.88	$10.61 to	11.11	10.10	11.62
June	13.64	14.15	11.36	12.63	10.10	11.87	10.10	10.86
July	13.64	14.65	11.87	13.14	11.62	12.38	....	
August	13.64	14.15	11.62	12.88	11.36	12.62	....	
September	13.64	14.15	11.36	13.14	11.11	12.38	....	
October	13.64	14.40	10.61	12.63	10.10	11.36	....	
November	13.14	13.64	10.10	12.12	10.10	11.62	....	
December	13.14	13.64	11.11	12.12	11.11	11.87	....	

The next table gives the number of British cattle offered for sale at the London market annually since 1880, together with the top rates obtained per 100 pounds dressed weight. Foreign cattle are not taken account of in this list, but all the different classes of animals mentioned in connection with the preceding table—butchering cows, bulls, etc.—are included.

Annual arrivals of British cattle in London since 1880.

Year.	Number.	Top rate.	Year.	Number.	Top rate.
1880	202,860	$19.20	1892	88,371	$16.17
1881	188,870	19.20	1893	110,250	15.66
1882	174,480	19.20	1894	99,020	14.65
1883	150,440	19.20	1895	99,660	16.17
1884	157,820	18.69	1896	78,930	15.66
1885	182,000	17.68	1897	78,580	15.16
1886	209,340	16.17	1898	76,745	14.65
1887	223,600	16.17	1899	83,586	15.66
1888	175,950	16.17	1900	78,490	15.16
1889	154,370	16.17	1901	71,320	16.17
1890	132,380	15.66	1902	81,960	....
1891	115,040	16.67	1903	68,210	15.66

Next is given the monthly arrivals of British and foreign sheep and lambs, followed by a table of the top rates in each instance. To compare the latter with live-weight prices the same procedure may be adopted as was suggested in connection with cattle. If it is assumed that the sheep dressed an average of 55 per cent and the lambs 52½ per cent, then the prices quoted are equivalent to 182 pounds live weight for sheep and 190 pounds for lambs.

Arrivals of British and foreign sheep and lambs in London in 1903.

Month.	British.	United States.	Canadian.	Argentine.
January	37,540	423	....	....
February	38,450	749	....	....
March	47,090	....	1,053	9,968
April	46,350	....	....	26,004
May	44,320	1,083	317	26,279
June	58,040	313	148	3,844
July	48,390	....	9,516	....
August	45,280	2,680	8,238	....
September	36,180	635	3,051	....
October	31,800	521	6,918	....
November	33,550	970	12,809	....
December	26,750	1,261	9,907	....
Total, 1903	493,690	8,635	41,957	66,095
Total, 1902	481,980	38,765	41,050	....

Top rates per 100 pounds dressed weight of British and foreign sheep and lambs in London in 1903.

Month.	British.		United States.		Canadian.		Argentine.	
	Lambs.	Sheep.	Lambs.	Sheep.	Lambs.	Sheep.	Lambs.	Sheep.
January	$21.72	$19.20	....	$15.16	....	....	....	....
February	23.24	18.69	....	14.65	....	....	....	....
March	24.25	19.20	....	....	$18.19	$14.65	....	$15.16
April	23.24	18.69	....	....	....	....	$15.66	14.15
May	20.71	20.21	....	12.63	....	....	....	13.14
June	20.21	17.18	....	12.63	....	....	....	....
July	20.21	17.18	....	....	....	12.12	....	....
August	20.21	17.18	....	13.14	....	13.14	....	....
September	18.19	17.18	....	12.63	15.16	12.12	....	....
October	17.68	17.18	....	12.12	....	12.12	....	....
November	....	18.19	....	11.62	15.66	11.87	....	....
December	21.22	18.19	....	12.12	14.65	11.62	....	....

The following table shows the total number of British sheep and lambs placed on the London market annually since 1880, together with the top rates for the same. The latter are for 100 pounds dressed weight in each instance, as given throughout these tables.

Annual arrivals of British sheep and lambs in London since 1880.

Year.	Number.	Top rate.	Year.	Number.	Top rate.
1880	872,910	$21.72	1892	755,620	$18.19
1881	726,590	22.23	1893	877,810	18.19
1882	561,600	24.25	1894	835,160	19.20
1883	537,590	24.76	1895	746,580	19.70
1884	603,220	22.23	1896	644,730	20.21
1885	742,740	19.70	1897	594,590	18.69
1886	748,820	20.21	1898	538,180	17.68
1887	773,120	19.70	1899	547,090	18.69
1888	698,380	19.70	1900	498,130	19.20
1889	746,140	20.71	1901	516,580	18.69
1890	676,890	21.22	1902	....	....
1891	772,590	18.69	1903	493,690	19.20

The total number of calves offered for sale during 1903 was 2,230, all British; the highest prices obtained were during March and April, when the best on offer were quoted at from $19.20 to $19.70 per 100 pounds dressed weight.

Hogs maintained a steady trade during the chief season, which is from September to December, with little variation in values; the general top rate was $13.14 to $13.64 per 100 pounds dressed. The total number placed on the London market during the year was 1,350.

EXPORTS OF ANIMAL PRODUCTS TO GERMANY.

Our trade in animal products with the German Empire picked up considerably last year, the total value of our exports having been $23,774,953 against $21,717,663 for 1902, which shows an increase of $2,057,290. This improvement is, unfortunately, likely to be short lived, as the tariff changes which are scheduled to go into effect during the present year will, without doubt, hurt the trade greatly. The new duties will be almost prohibitive so far as the majority of the items are concerned.

The table which follows shows our exports of animal products to Germany for the past two years. It will be seen by a glance down the list that over two-thirds of the entire trade is composed of one item, namely, lard. The amount of this product exported last year was 174,877,447 pounds, which was valued at $16,525,877. The amount for 1902 was 150,157,720 pounds, valued at $15,088,075. There was therefore a gain of very close upon $1,500,000 in 1903. There was a slight fall in the average unit price, but this was to be expected after the inflated prices of 1902. The figure, nevertheless, remained surprisingly high, the drop amounting to one-half cent only and the price remaining practically 1 cent higher than two years ago. The average prices per pound of this product exported to Germany for the past three years were, in 1901, 8.52 cents; in 1902, 10.05 cents; in 1903, 9.45 cents.

There were only two other items on the list that exceeded $1,000,000 in value, these being oleo oil (including oleomargarine; the latter, however, only a small proportion of the total—about 5 per cent) and bacon. The exports of oleo oil last year amounted to 31,884,775 pounds, valued at $2,819,220; the quantity and value in 1902 were, respectively, 24,052,520 pounds and $2,368,574. Thus there was an increase in value last year of close upon half a million dollars. The exports of bacon remained about stationary, the value of the shipments of 1903 having been $1,426,046 and the total for 1902 $1,455,434.

A number of the items which appear on the list are, as stated in the footnote, taken from the German reports, which are given in greater detail than ours. It will be seen that at least two of these items are of some importance, namely, sausage casings and stearin. Both of these products showed a considerable advance last year, stearin going from 11,584,291 pounds to 16,161,482 pounds and sausage casings from 14,742,381 pounds to 17,798,397 pounds.

The quantities and values of our exports of animal products to Germany for the calendar years 1902 and 1903, so far as ascertainable, are as follows:

Quantity and value of animals and animal products purchased by Germany from the United States in 1902 and 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Article.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
Albumin[a]	149,031	....	653,223	....
Bones, horns, and hoofs[a]	3,042,128	....	4,961,232	....
Bristles[a]	242,286	....	100,530	....
Dairy products:				
Butter	7,837	1,138	481,054	74,344
Cheese	4,160	406	5,800	804
Lactose[a]	173,061	....	398,592	....
Feathers[a]	214,287	....	54,674	....
Hides and skins (other than furs)	5,565,901	417,124	5,708,367	460,079
Horsehair[a]	187,611	....	82,672	....
Horses ....number..	137	16,475	185	27,853
Leather:				
Sole	76,470	15,370	82,315	16,073
Upper and other	....	774,246	....	803,536
Meats and meat products:				
Beef, canned	529,883	52,738	1,172,294	117,920
Beef, salted, etc	8,987,524	646,317	8,922,471	575,088
Pork	5,793,297	498,230	3,130,886	289,908
Bacon	16,106,995	1,455,434	15,260,392	1,426,046
Hams	1,389,295	139,792	892,543	91,518
Lard	150,157,720	15,088,075	174,877,447	16,525,877
Tallow	3,278,429	213,797	10,647,290	546,687
Stearin, etc.[a]	11,584,291	....	16,161,482	....
Oleo oil, etc	24,052,520	2,368,574	31,884,775	2,819,220
Other animal fat[a]	1,175,934	....	3,475,331	....
Sausage casings[a]	14,742,381	....	17,798,397	....
Wool, raw[a]	383,380	....	171,959	....
Total	....	21,717,663	....	23,774,953

[a] Taken from German official returns, which give quantities but not values.

IMPORTS OF ANIMAL PRODUCTS INTO GERMANY.

A comparative list of the entire purchases of animals and animal products by Germany for the years 1902 and 1903 is given below. The respective totals are seen to amount to $312,661,552 and $347,431,686, thus showing an increase last year of $34,770,134. These figures are quite large when compared with similar ones for the United States and for France, published in other parts of this article. They are, in fact, more than double the total of either one of the countries named, and therefore greater than the two combined. The German figures are, in turn, quite as decisively eclipsed by those of the United Kingdom (shown on page 553); the latter are, in fact, considerably larger than the aggregate for all the other countries named. By far the largest single amount in the table of German imports below is raw wool. The different wool items, together with wool

yarns, total upward of $100,000,000, almost one-third of the entire list. Meats and meat products come next, with a total almost as large, though composed of a much greater number of articles. The big items among the meat products are eggs and lard.

The importations of eggs last year were valued at $26,667,900, and the quantity involved would be in the neighborhood of 200,000,000 dozens. Nearly all these eggs were supplied by Russia and Austria-Hungary, the slightly larger proportion coming from the first-named country. Practically all the lard was supplied by us, this being also the case with oleomargarine (oleo oil) and stearin, but these are the only products on the list which are in any sense monopolized by us. We, however, furnished a larger proportion of tallow and sausage casings than any other country.

Germany imported an unusually large quantity of hides and skins in 1903. The increase was especially noticeable in respect to hides of cattle, the value of this item alone amounting to $27,120,814. Calfskins, horsehides, and the skins of the smaller domestic animals, though much less important than hides of cattle, were, in every case except the first, imported in much increased quantities. We contributed only an infinitesimal portion of these products, nor was our showing in leather much better. It may here be remarked that we furnished only about one-seventh of the boots and shoes imported into Germany. The total value of the imports of the latter was $2,163,182, more than half of which was supplied by Austria-Hungary.

The foreign horse trade of the German Empire is very large and important. Of the several classes mentioned in the table it will be seen that nearly all the animals imported are in the "working class." No less than 116,807 of these were brought in last year, of which number 63,234 were light working horses, most of which (41,921) came from Russia, and 53,573 were heavy working horses, the great majority of the latter coming from Denmark and Belgium (Denmark, 21,995; Belgium, 21,242). In regard to values, the light horses averaged $108 per animal, while the heavy horses brought a much higher price, the average cost having been $272. Germany is evidently not a large producer of horses, as she exports only a few, consequently the new fiscal laws will bear heavily on this trade. The tax on horses is now $4.76 per head, whereas the charge under the new law will be anywhere from $21.42 to $85.68 per head; but it should be stated that these figures are subject to revision by treaty.

The great majority of the cattle purchased by Germany are from Austria-Hungary. Russia has a monopoly of the live-hog trade, as, of the 78,579 hogs imported last year, all but 81 were supplied by that country. The balance of trade in sheep is in favor of Germany, as the imports are very light, while the exports are considerable, numbering about 150,000. There were 7,814,723 geese imported into

Germany in 1903, of which number no less than 6,613,870 were supplied by Russia, but in regard to live chickens rather more than half were contributed by Austria-Hungary, and the same applies to dead poultry.

The following is a list of values of the entire imports of animals and animal products into Germany for the calendar years 1902 and 1903, the German figures having been converted into American dollars:

Value of animals and animal products imported into Germany during the calendar years 1902 and 1903.

[Compiled from Auswärtiger Handel des Deutschen Zollgebiets, published by the German Government.]

Article imported.	1902.	1903.
Bones, horns, etc., and manufactures	$1,876,392	$1,898,526
Bone dust, boneblack, and bone ash	876,554	676,396
Glue, etc	419,356	361,760
Albumin	361,760	271,558
Feathers:		
Crude	4,164,048	4,269,720
Prepared	658,784	748,510
For quills	9,758	14,280
Bristles	4,982,292	5,043,934
Hides and skins:		
Hides of cattle	19,727,344	27,120,814
Calfskins	9,416,232	9,369,346
Horsehides	2,418,794	3,027,598
Sheepskins	2,225,776	5,051,074
Goatskins	3,024,028	3,511,452
All other hides and skins (not furs)	1,340,416	2,785,790
Hide cuttings	755,412	556,444
Leather	7,607,194	10,092,866
Meat and meat products:		
Beef, fresh	2,798,166	2,377,144
Pork, fresh	4,914,700	2,108,442
Mutton, fresh	43,316	38,318
Other fresh meats	714	952
Beef, salted, etc	733,754	923,678
Pork, salted, etc	1,535,814	852,516
Hams	822,528	492,422
Bacon	2,156,756	1,207,136
Sausage	38,318	42,126
All other prepared meats	17,850	13,328
Canned meats	10,234	10,234
Meat extracts	2,494,478	1,761,200
Poultry, dead	2,045,372	2,016,336
Lard	16,643,816	20,537,734
Tallow	3,722,320	3,937,710
Stearin, etc	874,412	1,130,262
Oleomargarine	4,388,244	6,398,392
Other animal fats	570,010	510,748
Sausage casings, etc	10,898,734	11,421,382
Eggs	27,419,980	26,667,900
Dairy products:		
Butter	6,076,140	9,462,642
"Melted butter"	317,016	344,862

Value of animals and animal products imported into Germany, etc.—Continued.

Articles imported.	1902.	1903.
Dairy products—Continued.		
Cheese	$5,035,128	$5,380,942
Milk and cream (fresh)	433,160	559,538
Buttermilk and whey	1,190	1,190
Condensed milk	1,904	4,760
Animals, live:		
Horses—		
Working, light	5,427,352	6,855,114
Working, heavy	13,553,862	14,582,260
For breeding	335,342	201,110
For pleasure	1,886,388	1,771,434
Ponies, etc	74,970	71,162
Foals (with mare)	10,472	16,422
Mules and asses	29,750	16,898
Cows	8,553,482	9,652,804
Steers	808,724	814,674
Oxen	7,288,988	10,041,934
"Young cattle"	4,753,336	5,665,352
Calves (under 6 weeks)	343,910	296,072
Hogs	1,696,940	2,244,102
Sucking pigs	8,806	5,474
Sheep	35,462	38,794
Lambs	238	476
Goats	14,994	19,040
Geese	5,024,180	6,007,596
Chickens	2,773,652	2,752,470
Other live poultry	895,832	965,090
Hair and wool:		
Horsehair	1,258,544	1,259,258
Horsehair, prepared	130,186	133,280
Horsehair, woven	66,640	82,586
Hair of alpaca, camel, etc	344,862	470,764
Other animal hair	1,189,286	1,023,162
Mohair and alpaca yarns	7,675,738	7,084,784
Yarn from cattle hair	85,918	110,432
Hair felt, etc	65,450	57,596
Wool, raw	46,559,702	59,010,910
Wool, scoured	15,203,202	11,923,086
Wool, combed	16,973,922	13,486,270
Wool waste and shoddy	1,059,814	1,819,748
Wool combings, etc	1,289,960	1,238,552
Wool yarns	13,383,454	14,711,018
Total	312,661,552	347,431,686

EXPORTS OF ANIMAL PRODUCTS TO FRANCE.

The Republic of France is akin to our own country in being to a large extent independent in the matter of the supply of animals and animal products, consequently our exports of these articles to French ports is very limited. It is, however, satisfactory to note a big improvement in last year's trade over that of 1902, the table below showing it had more than doubled.

The total value of our exports of animal products to France in 1903 was $2,232,516, while that of 1902 only totaled $1,018,866. The table, it will be seen, is composed of only three items which are of any considerable size—namely, tallow, lard, and leather. There was an increased trade in all of these during last year, the advance in the two former having been exceedingly large. The quantity of our tallow shipped to France in 1902 was 1,535,842 pounds, while the amount last year reached 12,729,106 pounds, or an increase of about 800 per cent. Shipments of lard in 1903 more than doubled as compared with 1902, the respective quantities having been 7,349,167 pounds and 3,035,846 pounds. The total value of the lard increased from $288,256 to $667,087.

All the lesser items of the table increased greatly, with two exceptions—canned beef and hams, both of which decreased, the former considerably and the latter slightly. On the other hand, more than three times as much bacon was sent over in 1903 as in 1902, but all the articles named are of such minor importance as regards total trade that unlooked for fluctuations are liable to occur in any year.

Our exports of animals and animal products to France in 1902 and 1903 are shown in the following table:

Quantity and value of animals and animal products purchased by France from the United States during the calendar years 1902 and 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
Hides and skins (other than furs)	125,279	14,145	977,578	94,573
Leather (upper)		507,493		605,688
Beef, canned	592,000	60,015	380,530	36,958
Beef, salted, etc	101,000	6,590	234,000	14,204
Tallow	1,535,842	95,834	12,729,106	694,746
Bacon	282,884	27,236	930,215	96,027
Hams	138,592	14,676	96,365	10,418
Pork	46,000	4,621	133,437	12,815
Lard	3,035,846	288,256	7,349,167	667,087
Total		1,018,866		2,232,516

IMPORTS OF ANIMAL PRODUCTS INTO FRANCE.

Appended is an itemized statement of the animals and animal products imported into France from all sources for the calendar years 1902 and 1903, similar to the lists previously given for the United Kingdom and Germany. A comparison of the totals of the lists in question will show that of France to be much smaller than the other two. The French list of imports is, in fact, to a great extent similar to our own in character and amount. The two largest items in both are the raw

products of hides and wool, the difference being that we purchase a greater quantity of the former than the French do, while they import a much larger supply of wool than we do. The amount opposite each of the articles in the table represents the value of such article consumed in France during the year; products merely passing through the country are excluded.

The total value of the animal products consumed in France in 1903 summed up to $153,702,305, which was an increase over the previous year of nearly $4,000,000. A glance down the columns shows there was no striking change in any of the chief articles; indeed, a remarkable uniformity is seen in the totals of the two years, and the increase referred to is distributed among a large number of the items. The somewhat minor item of tallow shows the largest percentage of increase, going from $1,450,009 to $2,708,562. We supplied about one-fourth of this tallow.

It will be noticed that the French purchase enormous quantities of foreign wool, not far from half the entire total being taken up by this raw product. Hides and skins is the only other large item, and of the smaller ones the most prominent are sheep, leather, and cheese, the latter being practically all Swiss cheese.

Value of animals and animal products imported into France during the calendar years 1902 and 1903.

[Compiled from "Tableau Général du commerce et de la navigation," published by the French Government.]

Article.	1902.	1903.
Live animals:		
Horses	$2,351,512	$2,545,863
Mules	165,980	162,120
Asses	47,092	58,672
Cattle	2,037,308	1,946,019
Sheep and lambs	7,425,675	8,022,045
Goats	8,299	11,580
Hogs	84,534	175,051
Poultry	333,697	293,553
Meats and meat products:		
Beef, fresh	345,470	316,520
Mutton, fresh	37,249	40,144
Pork, fresh	166,945	168,103
Beef, salt	33,003	37,249
Hams and bacon	1,341,543	1,312,979
Poultry, dead	373,262	371,911
Sausage	727,031	706,608
Sausage casings	234,881	265,761
Canned meats	79,323	71,410
Meat extracts	408,195	419,196
Tallow	1,450,009	2,708,562
Lard	499,098	846,305
Oleomargarine	23,739	14,861
Other animal fats	573,403	531,329
Eggs	4,258,159	4,073,844
Egg yolks (not for food)	248,198	387,737

Value of animals and animal products imported into France, etc.—Continued.

Article.	1902.	1903.
Dairy products:		
Butter	$3,154,971	$2,688,490
Cheese	7,051,062	6,982,547
Milk	12,931	10,808
Milk, condensed	99,202	108,852
Animal fertilizer	835,690	792,844
Bones, horns, etc	2,510,351	2,963,129
Bone, ground	61,374	135,679
Boneblack	54,426	59,058
Bristles	1,025,602	1,042,393
Feathers, crude	136,644	124,292
Feathers for quills	17,563	17,177
Hides and skins, raw	28,862,764	29,979,076
Hide cuttings	179,104	176,016
Leather	7,076,731	7,906,438
Horsehair	637,672	682,255
Hair of goat, etc	411,862	390,439
Mohair, combed or carded	115,221	106,343
Mohair yarns	1,097,205	1,237,902
Hair, other	169,261	241,250
Wool, raw	65,245,387	63,699,071
Wool, combed, colored, etc	130,275	159,611
Wool waste	4,258,159	5,704,887
Wool yarns	1,711,910	1,808,217
All other animal products	1,089,678	1,199,109
Totals	149,198,650	153,702,305

EXPORTS OF MEAT AND DAIRY PRODUCTS.

The series of tables which follow show the status of this important part of our foreign trade, firstly, by annual totals for each product from 1896 to 1903, and, secondly, in detail for the last-named year, showing the geographical distribution of each article.

BEEF PRODUCTS.

These consist of canned beef, fresh beef, and salted, pickled, or cured beef. (Tallow and oleo oil will be found under "Miscellaneous meat products.") Collectively there was an increase in the total value of beef products exported last year, as compared with 1902, of $2,500,000; but this does not bring the trade back to the level of three years ago, as the deficit in 1902 was $5,000,000. The recovery therefore amounted to one-half. Inasmuch as there were more cattle marketed in the United States last year than ever before in the history of the trade, the difficulty of overcoming a setback is apparent.

The only one of the beef products showing a falling off in 1903 is canned beef. The quantity exported in 1902 was 81,362,981 pounds, while that of last year was 66,738,931 pounds. However, the figures of 1902 were abnormally large, owing to unusual British and South

African orders, and last year's total is quite satisfactory when compared with that of 1901. In regard to unit prices of this product, we find the advance of 1902 practically maintained last year, as will be seen from the average prices per pound obtained for the exports in the last three years, as follows: 1901, 9.83 cents; 1902, 10.31 cents; 1903, 10.26 cents. A reference to the second table will show that our canned beef is very widely distributed geographically, although not in large quantities except to the United Kingdom and British Africa.

Fresh beef comprises the great bulk of our export trade in meat products. There were 293,401,843 pounds sent abroad last year, which compares favorably with the 242,015,093 pounds of the year before, but the table shows that last year's total was nevertheless inferior to those of 1901, 1900, and 1899. There was a decided settling in the prices last year, the average per pound reverting back to about the same point as in 1901. The price in the last-named year was 9.11 cents, that of 1902 (the scarce year) was 10.34 cents, and that of 1903 was 9.10 cents. The distribution table shows that practically all our exports of fresh beef are consumed in the United Kingdom. Out of the total of 293,401,843 pounds sent abroad last year no less than 291,790,863 pounds went to British ports.

Salt beef made a satisfactory advance in 1903, the total exports having been 58,154,546 pounds, as against 47,198,997 pounds for the year before and 52,528,512 pounds in 1901. The average price per pound obtained for salt beef last year was 6.37 cents, which, although less than the price of 1902 (7.15 cents), was a considerable advance on that of 1901, when it was 5.90 cents. Fully one-third of this product goes annually to the United Kingdom, but considerable quantities are purchased by other countries as well. The most important of these, as may be seen in the table, were Germany, British North America, West Indies, and South America.

HOG PRODUCTS.

The continued scarcity of the market supply of hogs during 1903 caused a further falling off in our exports of hog products for that year as compared with previous years. This, however, was not in any way serious except in the case of bacon. The drop in the shipments of this article was particularly marked, as will be seen by reference to the annual totals given in the accompanying table. There has been a decrease, in fact, every year since 1898, but it was not very large until the corn famine of 1901 reduced the shipments almost one-half, and there has been no recovery since. It is, however, satisfactory to note that the high prices of 1902 were more than maintained last year. The average amount per pound brought annually by the export bacon for the three years past was, in 1901, 8.80 cents; in 1902, 10.03 cents; in 1903, 10.21 cents. After the United Kingdom, our best customers

for bacon are Germany and Belgium, all other countries being much below these in regard to quantity purchased. The amount taken last year by each of the three countries named was: By the United Kingdom, 163,894,472 pounds; by Germany, 15,260,392 pounds; by Belgium, 11,340,581 pounds.

Contrary to bacon, hams have almost held their own during the past two years, and whereas a few years back the quantity of bacon exported was usually about three times as large as that of hams it will be seen that in 1903 they were not far from being equal. There seems to be no reason why the corn famine previously alluded to should not have had an equally disastrous effect on the exports of hams as it had on those of bacon. For want of a better explanation of this discrepancy, it is suggested that it may be due to a possible laxity in differentiating between the two products, and that in consequence more hams and, per contra, less bacon have appeared in the returns than was actually the case. Values were maintained last year in regard to hams even more satisfactorily than was the case with bacon, there having been an increase of one-fourth of a cent per pound over the high price of 1902. The average prices per pound of the hams exported in the past three years were as follows: 1901, 10.73 cents; 1902, 11.62 cents; 1903, 11.87 cents. The great bulk of our export hams is consumed in Great Britain. The table shows a wide distribution of the remainder, but generally in small quantities.

Canned pork is an unimportant item when compared with the other hog products; there is, however, a steady trade of about 10,000,000 pounds annually. Fresh pork shows a larger volume than the preceding, but the total has fallen off one-half in the past two years.

The only hog flesh other than hams and bacon of which there is a considerable foreign trade is salted or pickled pork; of this there were 107,082,084 pounds exported last year, as against 98,262,179 pounds in 1902 and 127,846,335 pounds in 1901. The unit value of this product has advanced in about the same proportion as the previously mentioned hog products, the average values for 1901, 1902, and 1903 having been, respectively, 8.02 cents, 9.57 cents, and 9.68 cents per pound.

Lard represents about one-fifth of the total value of all our exports of animals and animal products, and when the home consumption is added to the exports it can readily be seen that the production of this single article of trade is an industry of great magnitude. That our foreign commerce in lard is very highly developed may be judged from the fact, as shown by authoritative trade figures, that the exports annually exceed the home comsumption, the two together bringing the total production measurably near 1,000,000,000 pounds per annum. The exports of last year partially recovered from the stringency of 1902, but were, nevertheless, considerably below those of 1901. The total

sent abroad last year was 535,375,757 pounds; that of 1902 was 504,153,355 pounds, and that of three years ago 607,266,176 pounds. Lard values followed the rule last year by declining about three-quarters of a cent per pound, but the average price was, nevertheless, a distinct advance on that of two years ago. It may be interesting to show the average annual prices of our export lard for a number of years past, and thus show the rapid advance in values that has taken place. They are as follows:

Annual unit values of exports of lard since 1896.

	Cents.		Cents.
1896	5.67	1900	6.90
1897	5.18	1901	8.50
1898	5.90	1902	10.09
1899	6.02	1903	9.38

Fully one-third of our export lard is consumed in the United Kingdom, the quantity sent there last year having been 198,456,816 pounds out of the total of 535,375,757 pounds. Germany is also a very important customer, almost as large a proportion being taken by the Germans as by the British; last year's shipments to Germany reached 175,877,447 pounds. After these two countries, there is a big drop to the next one, which is Netherlands; the Hollanders average about 50,000,000 pounds yearly, last year's exports having been 53,603,949 pounds. Of the numerous other countries of destination, Belgium and Cuba only are worthy of mention.

MISCELLANEOUS MEAT PRODUCTS.

The most important of these is oleo and oleomargarine. This product is practically all exported in the form of the oil; margarine, or imitation butter, comprises rather less than 5 per cent of the total. The table shows a substantial gain in last year's export business, which totaled altogether 159,492,029 pounds; that of 1902 totaled 114,482,615 pounds; the gain, therefore, amounted to 45,009,414 pounds. The average price obtained for our oleo last year dropped 1 cent per pound, as compared with 1902, but it should be stated that the price in the last-named year was unusually high, as was the case, in fact, with most meat products, because of the prevailing scarcity; last year's price was therefore quite satisfactory, notwithstanding the shrinkage mentioned. The average prices per pound for the past three years were, for 1901, 7.91 cents; for 1902, 9.66 cents; 1903, 8.64 cents. Netherlands is our chief customer for oleo products, more than half the total going there annually. Germany is next, with about one-fifth of the total, no other country having a prominent share in the trade. The United Kingdom took less than 5 per cent last year, which was about the usual proportion, this being the only one of the meat and dairy products of which the British do not obtain the lion's share.

A remarkable advance occurred in the exports of tallow last year. The total shipments for the twelve months named reached 63,537,840 pounds; those of 1902 were only 21,365,465 pounds, while those of 1901 totaled 51,848,309 pounds. Thus it will be seen that the sensational decline of 1902 was more than recovered in 1903. There was a drop of 1 cent per pound in the average price last year as compared with 1902, the figures being 5.23 cents and 6.23 cents, respectively. The average price in 1901 was 5.21 cents—practically the same as that of last year. Tallow is a widely distributed product, although last year over two-thirds of the total was sent to the three principal purchasing countries, of which the United Kingdom headed the list, with 23,214,137 pounds; France came next, with 12,729,106 pounds; and Germany was a close third, with 10,647,290 pounds.

DAIRY PRODUCTS.

Our exports of butter, cheese, and milk have been of little importance for the last two years. Three years ago the shipments of these products were much heavier, but there was a serious falling off in 1902, and last year failed to show any reaction.

The exports of butter last year slightly exceeded those of 1902, the respective quantities having been 9,345,416 pounds and 8,959,316 pounds, but values went back considerably, as it can be seen from the table that the total value of the greater quantity is exceeded by that of the smaller. The average price per pound obtained for the exports last year was, in fact, 17.12 cents, while that of the year before was 18.77 cents, and that of 1901, 17.26 cents. As regards distribution, about one-half goes to Great Britain, the remainder being well scattered in small amounts.

It may be well here to call attention to the fact that Argentina is outstripping us in the export-butter trade. Complete figures for 1903 in respect to the latter country are not yet at hand, but a reliable comparison for the year named can be had by means of the British official returns. These show that receipts by Great Britain of United States butter have for some years been on the decrease, while receipts from Argentina have greatly increased, especially in the past two years. The British receipts of butter in 1903 from the respective countries were: From Argentina, 9,014,992 pounds, valued at $1,936,730; from United States, 4,749,360 pounds, worth $927,934. The unit values in each case work out to 21½ cents per pound for the Argentine product, and 19½ cents for the United States. Thus it appears that in this branch of trade our showing in the English market is inferior to that of Argentina, both as regards quantity and quality.

We export considerably more cheese than butter, and the total sent abroad last year was, similarly to butter, slightly in excess of the year previous. The contrary was the case, however, in respect to values, as the high price brought by the cheese of 1902 was more than main-

tained last year. The exact values of the exports for the three past years were: 9.57 cents in 1901, 11.05 cents in 1902, and 11.73 cents in 1903. With the exception of a number of small scattered amounts, our surplus cheese is all taken by the United Kingdom.

The exports of milk last year were valued at $1,018,063, which was a very slight decrease from the total for 1902. This article is no doubt mostly the condensed variety, as fresh milk is not a substance that can with facility be transported long distances. It may, however, be remarked in passing that our Dairy Division, in connection with our exhibit at the Paris Exposition of 1900, demonstrated the possibility of delivering American milk in good condition at the French capital, and that, too, without any other preservative than cold. The Treasury report from which these data are compiled gives only the total value of the milk exported each year, omitting quantity and distribution, the latter omission being customary with items of small size; therefore the unit values and destination of this product can not be stated.

The annual quantities and values of the domestic exports of each of the foregoing products since 1896 are as follows:

GENERAL TABLES OF EXPORTS.

Exports of meats and meat products and dairy products for the years 1896 to 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Article	Quantity.	Value.	Article.	Quantity.	Value.
Beef, canned:	*Pounds.*	*Dollars.*	Tallow:	*Pounds.*	*Dollars.*
1896	61,168,927	5,335,283	1896	85,449,086	3,336,111
1897	42,804,831	3,728,607	1897	55,609,096	2,029,735
1898	37,866,632	3,448,240	1898	106,819,190	4,209,395
1899	49,393,218	4,529,550	1899	97,213,186	4,283,751
1900	51,915,745	5,150,013	1900	92,555,436	4,674,801
1901	53,239,582	5,233,782	1901	51,846,765	2,698,692
1902	81,362,981	8,384,454	1902	21,365,465	1,330,604
1903	66,738,931	6,850,079	1903	63,537,840	3,320,080
Beef, fresh:			Bacon:		
1896	282,925,463	22,498,251	1896	436,859,660	31,057,506
1897	279,882,590	22,298,328	1897	578,082,822	39,820,382
1898	267,458,906	22,644,040	1898	619,683,235	45,786,045
1899	322,635,630	28,194,697	1899	558,005,388	41,008,919
1900	326,356,576	29,307,778	1900	469,924,828	37,099,980
1901	354,421,731	32,294,877	1901	447,620,337	39,402,500
1902	242,015,093	25,028,304	1902	270,141,141	27,101,431
1903	293,401,843	26,692,858	1903	213,519,817	21,800,532
Beef, salted, etc.:			Hams:		
1896	85,893,296	4,707,094	1896	156,912,852	15,224,842
1897	43,854,117	2,244,568	1897	171,956,663	16,581,659
1898	48,724,793	2,737,304	1898	220,011,750	20,384,650
1899	46,065,647	2,617,828	1899	216,646,559	21,015,536
1900	56,351,147	3,277,680	1900	198,328,048	21,043,597
1901	52,528,512	3,099,492	1901	230,456,004	24,739,003
1902	47,198,997	3,375,401	1902	224,982,389	26,151,091
1903	58,154,546	3,703,177	1903	205,494,949	24,383,626

Exports of meats and meat products and dairy products, etc.—Continued.

Articles.	Quantity.	Value.	Article.	Quantity.	Value.
Pork, salted or pickled:	*Pounds.*	*Dollars.*	Sausage casings:	*Pounds.*	*Dollars.*
1896	63,544,168	3,204,986	1896		1,686,930
1897	68,764,530	3,563,945	1897		1,677,033
1898	116,865,578	6,804,048	1898		1,762,431
1899	137,573,905	7,996,794	1899		1,899,164
1900	140,915,057	9,380,615	1900		2,931,603
1901	127,863,335	10,254,695	1901		2,022,496
1902	98,262,179	9,404,635	1902		1,755,293
1903	107,082,084	10,367,223	1903		2,220,126
Pork, fresh:			Meat products not specified:		
1896	315,345	18,161			
1897	4,185,059	289,237	1896		2,413,281
1898	30,464,516	2,027,565	1897		3,243,188
1899	34,041,243	2,334,826	1898		5,190,547
1900	25,576,765	1,987,566	1899		5,810,955
1901	40,348,780	3,224,726	1900		5,015,000
1902	31,171,784	2,764,950	1901		5,672,446
1903	20,900,694	1,962,557	1902		4,487,623
Pork, canned:			1903		4,215,131
1899 *a*	3,570,524	270,577	Poultry and game:		
1900	9,368,005	744,197	1896		51,981
1901	9,341,262	744,455	1897		66,316
1902	13,044,954	1,240,331	1898		91,819
1903	10,817,461	1,127,495	1899		236,322
Lard:			1900		679,440
1896	526,320,203	29,821,308	1901		866,322
1897	630,060,611	32,622,409	1902		847,430
1898	736,636,222	43,440,170	1903		1,138,816
1899	690,068,669	41,531,142	Butter:		
1900	609,473,372	42,033,597	1896	27,220,213	3,909,900
1901	607,266,176	51,626,346	1897	30,914,783	4,497,878
1902	504,153,355	50,869,699	1898	15,034,189	2,428,143
1903	535,375,757	50,224,669	1899	27,309,869	4,502,744
Mutton:			1900	13,283,557	2,396,062
1896	342,431	27,173	1901	24,249,565	4,184,966
1897	519,986	41,456	1902	8,959,316	1,681,723
1898	285,527	22,147	1903	9,345,516	1,600,323
1899	719,399	57,290	Cheese:		
1900	735,675	53,215	1896	44,530,234	3,846,703
1901	298,700	22,815	1897	60,180,651	5,432,371
1902	3,790,019	319,327	1898	40,523,994	3,376,818
1903	2,780,265	253,384	1899	34,686,833	3,376,108
Oleo oil and oleomargarine:			1900	54,059,049	5,549,254
1896	120,686,267	8,255,849	1901	31,396,115	3,006,344
1897	122,055,911	7,391,091	1902	19,095,438	2,109,347
1898	142,272,339	8,654,721	1903	19,634,239	2,302,118
1899	144,438,709	10,241,347	Milk:		
1900	164,321,706	11,985,976	1896		397,181
1901	168,923,216	13,451,234	1897		635,370
1902	114,482,615	11,124,850	1898		692,925
1903	159,492,029	13,780,049	1899		1,188,057
Sausage and sausage meats:			1900		1,288,127
1900 *a*	5,867,982	543,804	1901		1,646,579
1901	7,140,383	699,841	1902		1,090,051
1902	6,328,527	672,770	1903		1,018,063
1903	5,262,081	586,384			

a Included in "All other meat products" previous to 1899.

The geographical distribution (by quantities and values) of each of the above products for the calendar year 1903 is shown in the following tables:

Quantity and value of exports of meat and meat products and dairy products for the calendar year 1903, by countries.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Article, and country to which exported.	Quantity.	Value.
Beef, canned:	*Pounds.*	*Dollars.*
United Kingdom	48,822,078	5,011,789
Belgium	566,250	57,096
France	380,530	36,958
Germany	1,172,294	117,920
Italy	103,026	10,293
Netherlands	401,200	40,050
Other Europe	936,383	94,071
British North America	672,665	70,088
Central American States and British Honduras	226,379	21,376
Mexico	160,889	16,910
Cuba	63,458	5,597
Other West Indies and Bermuda	640,623	63,668
Argentina	3,102	308
Brazil	73,517	8,275
Colombia	129,424	12,285
Other South America	257,757	26,489
Chinese Empire	49,497	5,449
British East Indies	152,619	14,158
Hongkong	213,398	22,528
Japan	48,463	4,840
British Australasia	180,410	16,191
Philippine Islands	347,301	37,074
Other Asia and Oceania	91,035	9,952
British Africa	10,377,997	1,080,665
All other Africa	668,636	66,049
Total	66,738,931	6,850,079
Beef, fresh:		
United Kingdom	291,790,863	26,544,184
British North America	381,729	36,964
West Indies and Bermuda	1,143,062	103,260
Other countries	86,189	8,450
Total	293,401,843	26,692,858
Beef, salted, etc.:		
United Kingdom	20,654,633	1,395,339
Belgium	1,948,810	119,639
France	234,000	14,204
Germany	8,922,471	575,088
Netherlands	1,330,860	87,159
Other Europe	4,015,945	226,463
British North America	7,248,651	412,157
Central American States and British Honduras	744,133	46,771
Mexico	18,881	1,366
Cuba	23,885	1,389
Other West Indies and Bermuda	5,392,626	335,502
Brazil	30,150	2,020

Quantity and value of exports of meat and meat products, etc.—Continued.

Article, and country to which exported.	Quantity.	Value.
Beef, salted, etc.—Continued.	*Pounds.*	*Dollars.*
Chile	99,130	6,419
Colombia	265,218	16,103
Other South America	3,539,475	215,979
Asia and Oceania	2,604,140	183,543
British Africa	878,838	51,993
Other Africa	147,800	9,486
Other countries	54,900	2,557
Total	58,154,546	3,703,177
Tallow:		
United Kingdom	23,214,137	1,170,902
Belgium	3,126,200	156,370
France	12,729,106	694,746
Germany	10,647,290	546,687
Italy	2,250,088	123,986
Netherlands	3,228,165	169,029
Other Europe	3,624,193	186,159
British North America	17,061	956
Central American States and British Honduras	1,397,027	83,821
Mexico	123,117	6,331
Cuba	577,435	30,189
Other West Indies and Bermuda	975,371	54,463
Brazil	114,132	8,063
Chile	361,620	21,977
Colombia	112,723	6,980
Other South America	959,762	55,226
Asia and Oceania	72,210	3,661
Other countries	8,203	531
Total	63,537,840	3,320,080
Bacon:		
United Kingdom	163,894,472	16,892,518
Belgium	11,340,581	1,083,876
France	930,215	96,027
Germany	15,260,392	1,426,046
Netherlands	2,337,661	230,960
Other Europe	7,777,669	729,014
British North America	5,300,412	619,218
Central American States and British Honduras	287,747	30,105
Mexico	252,499	36,289
Cuba	3,409,956	322,383
Other West Indies and Bermuda	306,336	39,909
Brazil	1,657,492	187,438
Colombia	23,183	2,696
Other South America	157,531	16,947
Chinese Empire	139,857	23,437
Philippine Islands	179,105	27,899
Other Asia and Oceania	140,464	23,324
British Africa	62,961	6,596
Other Africa	61,284	5,850
Total	213,519,817	21,800,532
Hams:		
United Kingdom	177,745,090	21,193,635
Belgium	4,818,973	507,089
France	96,365	10,418

Quantity and value of exports of meat and meat products, etc.—Continued.

Article, and country to which exported.	Quantity.	Value.
Hams—Continued.	*Pounds.*	*Dollars.*
Germany	892,543	91,518
Netherlands	1,154,151	121,901
Other Europe	2,444,581	274,425
British North America	8,683,054	1,030,210
Central American States and British Honduras	236,303	29,403
Mexico	551,764	73,314
Cuba	5,223,192	576,763
Other West Indies and Bermuda	1,573,738	199,186
Brazil	20,356	2,691
Colombia	115,897	14,694
Venezuela	310,044	42,449
Other South America	384,397	48,734
Chinese Empire	201,892	31,752
British Australasia	3,715	482
Philippine Islands	169,468	24,362
Other Asia and Oceania	239,913	35,842
British Africa	612,059	72,730
Other Africa	7,387	899
Other countries	10,067	1,165
Total	205,494,949	24,383,662
Pork, canned	10,817,461	1,127,495
Pork, fresh and salted:		
United Kingdom	71,432,291	7,215,877
Belgium	4,961,973	475,255
France	133,437	12,815
Germany	3,130,886	289,908
Netherlands	2,472,272	236,808
Other Europe	11,791,314	1,049,993
British North America	12,132,967	1,017,049
Central American States and British Honduras	1,462,541	133,754
Cuba	3,206,427	273,938
Other West Indies and Bermuda	8,596,447	765,384
Brazil	351,050	30,488
Colombia	163,043	14,731
Other South America	3,209,706	285,474
Philippine Islands	81,048	8,438
Other Asia and Oceania	707,045	73,292
British Africa	4,059,016	438,337
Other Africa	17,100	1,431
Other countries	74,215	6,808
Total	127,982,778	12,329,780
Lard:		
United Kingdom	198,456,816	18,812,984
Belgium	28,525,453	2,602,238
France	7,349,167	667,087
Germany	174,877,447	16,525,877
Italy	4,085,984	406,994
Netherlands	53,603,949	5,068,260
Other Europe	17,400,963	1,557,678
British North America	1,724,912	162,914
Central American States and British Honduras	1,398,427	116,400
Mexico	2,794,225	257,244

Quantity and value of exports of meat and meat products, etc.—Continued.

Article, and country to which exported.	Quantity.	Value.
Lard—Continued.	*Pounds.*	*Dollars.*
Cuba	16,630,335	1,408,673
Other West Indies and Bermuda	7,258,989	638,575
Argentina	48,000	5,037
Brazil	5,063,951	503,911
Chile	783,407	79,997
Colombia	3,529,794	309,497
Venezuela	3,788,822	336,951
Other South America	4,131,399	368,928
Philippine Islands	224,829	22,981
Other Asia and Oceania	885,414	84,941
British Africa	2,408,492	247,319
Other Africa	376,582	38,123
Other countries	28,400	2,459
Total	535,375,757	50,224,669
Mutton	2,780,265	253,384
Oleo and oleomargarine:		
United Kingdom	6,602,645	563,866
Germany	31,884,775	2,819,220
Netherlands	88,302,276	7,713,140
Other Europe	27,959,259	2,228,144
British North America	1,850,775	158,844
Central American States and British Honduras	72,727	6,732
Mexico	109,414	14,739
West Indies and Bermuda	2,343,197	239,559
Colombia	125,496	10,943
Other South America	154,735	15,617
Asia and Oceania	35,971	3,953
Other countries	50,759	5,292
Total	159,492,029	13,780,049
Sausage and sausage meats	5,262,081	586,384
Sausage casings	....	2,220,126
Meat products not specified:		
Canned	....	2,157,182
All other	....	2,057,949
Poultry and game	....	1,138,816
Butter:		
United Kingdom	4,020,418	676,328
Germany	481,054	74,344
Other Europe	300,393	45,237
British North America	519,065	110,608
Central American States and British Honduras	227,552	50,520
Mexico	403,310	84,607
Cuba	102,913	21,301
Other West Indies and Bermuda	1,289,027	220,729
Brazil	782,025	99,190
Colombia	129,133	23,935
Venezuela	570,649	83,523
Other South America	159,357	29,190
Chinese Empire	23,045	5,754
Japan	293,372	64,285
Philippine Islands	30	10

Quantity and value of exports of meat and meat products, etc.—Continued.

Article, and country to which exported.	Quantity.	Value.
Butter—Continued.	*Pounds.*	*Dollars.*
Other Asia and Oceania	27,177	6,963
British Africa	11,843	2,945
Other Africa	321	94
Other countries	4,732	760
Total	9,345,416	1,600,323
Cheese:		
United Kingdom	17,855,068	2,052,206
Germany	5,800	804
British North America	93,036	13,552
Central American States and British Honduras	172,610	23,789
Mexico	282,738	37,573
Cuba	55,961	10,220
Other West Indies and Bermuda	656,975	87,287
Brazil	267	37
Colombia	58,156	8,035
Other South America	10,973	1,626
Chinese Empire	162,070	23,630
Japan	56,312	8,597
Philippine Islands	7,287	1,143
Other Asia and Oceania	211,772	32,665
Other countries	5,214	954
Total	19,634,239	2,302,118
Milk	....	1,018,063

WOOL AND WOOL MANUFACTURES.

IMPORTS.

The annexed tables show that the value of our imports of wool and wool manufactures in 1903 aggregated $42,133,238, the wool amounting to $22,811,734 and the manufactures to $19,321,504. These figures denote an increase of close upon $4,000,000 when compared with the totals of 1902, and it will be seen that this advance applies both to the manufactures and to the raw wools, with the exception of class 1 of the latter (clothing wool). The increase in the manufactures was only slight, the total value for last year having been $19,321,504, against $18,771,774 for 1902, which makes the increase $549,730. This small advance makes a much more satisfactory showing for our cloth makers than was the heavy increase—over $3,000,000—which occurred in 1902. In regard to the unmanufactured product, clothing wool fell off, as before intimated, from $7,333,855—the total of 1902—to $6,942,447, which was the total for last year. The wools of class 2, designated combing wools, which also include mohair, camel's hair, etc., advanced from $2,003,527 to $2,635,035. By far the greatest advance, however, occurred in the cheaper grades of wool, known as class 3, or carpet wools. The latter, it may be remarked, usually

contain a small quantity (from 1 to 2 per cent) of Russian camel's hair. The importations of carpet wools in 1903 were valued at $13,234,252, which was within a few thousands of being $3,000,000 in excess of the previous year. A study of the table will reveal a peculiar fact in regard to the volume of trade in the several classes of wool. It will be seen that in the years 1895 to 1897 the wools chiefly imported were those of class 1, class 3 coming next, but far below the first named. Since the change in the tariff, however, the carpet wools have annually exceeded the clothing wools in value, with the single exception of 1900, when the values were practically equal. We may draw from this the satisfactory inference that the domestic supply of the better grades of wool is more adequate than that of the poorer kinds; in other words, that our wool growers raise a superior rather than an inferior staple. Last year's importation of carpet wools, it will be noticed, was greater than any on the list, exceeding even the totals of the free-trade years.

In regard to the sources of supply of our wool imports, the returns show that practically all the clothing wools are obtained from the three following territorial divisions, each of which last year contributed about an equal proportion, namely, Asia and Oceania, South America, and the United Kingdom. The first of these, no doubt, are largely Australasian wools; the South American wools would be chiefly from Argentina; and the imports from the United Kingdom are probably mostly Australasian wool reshipped. It may be noted that the South American product is of inferior quality to the Australasian, and that the quantity annually received of the former has been decreasing, while the direct importations of Australasian wool have been on the increase. There was a very remarkable rise in the values of wools of class 1 during the past year, the average price per pound of the imports having been 18.41 cents, as against 13.11 cents for 1902 and 13.35 cents for 1901.

Over two-thirds of the imports of class 2, combing wools, is supplied by the United Kingdom, practically none coming from South America or Australasia. There was a considerable advance in values in this class also, the average price last year having risen to 20.63 cents per pound from 18.05 cents for 1902 and 18.59 cents for 1901.

Class 2 includes mohair, this important article of commerce comprising about 20 per cent of the total quantity of this class. Mohair, however, averages much higher in value than the wools, the price of the former for the past three years having averaged above 30 cents per pound.

Carpet wools are supplied to us in large quantities through the United Kingdom, fully one-third of the total coming from British ports; nearly as much comes from the eastern portion of Europe, and a large quantity is furnished by China. The two latter sources were

responsible for an increased supply in the past year, while that from the United Kingdom decreased somewhat. Values rose in this class in about the same ratio as in class 2. The average cost per pound of the imports of carpet wools for three years past has been 10.75 cents in 1903, 9.38 cents in 1902, and 9.52 cents in 1901.

Nearly half the imports of wool manufactures is composed of women's and children's dress goods, the two other important divisions being cloths and carpets. The different classes of the manufactures, with the quantity and value of each imported in 1903, were as follows: Dress goods, 44,529,475 square yards, valued at $8,202,903; cloths, 4,431,051 pounds, costing $4,567,641; carpets and carpeting, 1,041,711 square yards, with a value of $3,634,714; ready-made clothing valued at $1,559,804; knit fabrics, $512,624; yarns, 250,569 pounds, with a valuation of $153,644; mungo, shoddy, etc., 312,861 pounds, valued at $78,800; shawls, $55,277; all other, $556,097; total manufactures, $19,321,504.

It will be seen that the United Kingdom supplies far the larger portion of the dress goods and the cloths which we import; France is the next largest contributor by reason of a large share in the dress-goods trade; Germany is the only other country that sends any quantity worth mentioning, about one-fourth of the cloths and one-eighth of the dress goods coming from German sources. Continental Europe supplies the greater part of the carpets and carpeting.

Below are statements showing (1) the total values of each of the several classes of wool and of the manufactures imported annually, since 1892, and (2) the imports of 1903 in detail:

Value of imports of wool and wool manufactures for the years 1892 to 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Calendar year.	Class 1 (clothing wool).	Class 2 [a] (combing wool).	Class 3 (carpet wool).	Manufactures.	Total.
1892	$9,309,640	$1,375,651	$10,505,348	$37,515,445	$58,703,084
1893	5,373,238	895,266	7,485,045	30,238,506	44,182,055
1894	5,315,919	1,166,150	6,780,443	17,342,682	30,605,194
1895	19,657,912	4,092,656	10,019,591	60,319,331	94,089,490
1896	13,077,712	2,032,169	7,311,533	37,109,363	59,530,777
1897	33,953,828	6,946,102	12,532,300	29,330,284	82,762,214
1898	4,639,220	301,337	6,646,019	13,834,296	25,420,872
1899	2,803,680	1,499,276	7,356,688	14,596,847	26,256,491
1900	8,498,228	2,235,096	8,476,738	15,806,112	35,016,174
1901	5,726,006	981,294	7,310,132	15,604,532	29,621,964
1902	7,333,855	2,003,527	10,252,845	18,771,774	38,362,001
1903	6,942,447	2,635,035	13,234,252	19,321,504	42,133,238

[a] Includes mohair, camels' hair, etc.

Quantity and value of imports of wool and wool manufactures (including hair of goat, camel, etc.) for the calendar year 1903, by countries.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Country from which imported.	Quantity.	Value.
CLASS 1.—*Clothing wool.*	*Pounds.*	*Dollars.*
United Kingdom	10,929,522	1,925,468
France	35,604	4,550
South America	12,894,711	1,792,157
Asia and Oceania	13,174,993	3,102,841
Other countries	671,860	117,431
Total	37,706,690	6,942,447
CLASS 2.—*Combing wool.*		
United Kingdom	8,890,226	1,685,492
Other Europe	1,614,862	393,062
British North America	1,422,264	238,450
South America	761,849	294,905
Asia and Oceania	74,432	22,188
Other countries	7,299	938
Total	12,770,932	2,635,035
CLASS 3.—*Carpet wool.*		
United Kingdom	34,625,570	4,123,748
France	3,100,998	332,977
Germany	2,889,837	318,573
Other Europe	32,529,358	3,700,279
British North America	22,221	2,262
South America	10,163,394	937,362
Chinese Empire	24,224,160	2,098,025
Other Asia and Oceania	13,753,318	1,575,766
Other countries	1,787,413	145,260
Total	123,096,269	13,234,252
Total unmanufactured	173,573,891	22,811,734
MANUFACTURES.		
Carpets and carpeting:	*Sq. yards.*	
United Kingdom	266,799	651,873
Other Europe	566,707	2,326,932
Japan	165	455
Other Asia and Oceania	206,174	648,335
Other countries	1,866	7,119
Total	1,041,711	3,634,714
Clothing	....	1,559,804
Cloths:	*Pounds.*	
United Kingdom	2,668,441	2,816,722
Austria-Hungary	177,087	163,618
Belgium	201,439	196,681
France	213,819	281,610
Germany	1,151,537	1,090,832
Other Europe	3,608	3,355
Other countries	15,120	14,823
Total	4,431,051	4,567,641
Dress goods:	*Sq. yards.*	
United Kingdom	29,046,176	4,523,852
France	10,286,135	2,505,306
Germany	5,109,679	1,150,222

Quantity and value of imports of wool and wool manufactures, etc.—Continued.

Country from which imported.	Quantity.	Value.
MANUFACTURES—continued.		
Dress goods—Continued.	*Sq. yards.*	*Dollars.*
Other Europe	71,642	19,946
Other countries	15,843	3,577
Total	44,529,475	8,202,903
All other manufactures	....	1,356,442
Total manufactures	....	19,321,504

EXPORTS.

Owing to the insufficiency of the home supply, it follows that our exports of domestic wool products are of minor consequence. What little trade there is, however, seems to be of a satisfactory nature, inasmuch as the annual totals of the chief item—the manufactures—show a steady upward tendency for a number of years past.

The accompanying tables exhibit the annual total values of the exports of wool and wool manufactures since 1892 and the shipments of 1903 in as much detail as the returns will permit:

Value of exports of wool and wool manufactures for the years 1892 to 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Calendar year.	Raw wool.	Manufactures.	Total.
1892	$38,799	$273,835	$312,634
1893	36,139	559,379	595,518
1894	232,162	736,360	968,522
1895	689,874	782,855	1,472,729
1896	968,866	945,103	1,913,969
1897	144,608	1,058,956	1,203,564
1898	14,406	1,020,810	1,035,216
1899	566,295	1,229,539	1,795,834
1900	59,338	1,429,733	1,489,071
1901	15,039	1,531,972	1,547,011
1902	63,814	1,588,058	1,651,872
1903	43,347	2,002,913	2,046,260

Quantity and value of exports of domestic wool and wool manufactures for the calendar year 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Article.	Quantity.	Value.
	Pounds.	*Dollars.*
Raw wool	383,965	43,347
Manufactures:	*Yards.*	
Carpets	71,434	60,920
Dress goods	14,136	7,518
Flannels and blankets	....	111,115
Wearing apparel	....	1,458,255
All other	....	365,105
Total	....	2,002,913

HIDES AND SKINS.

Hides and skins (other than furs) form a very important part of the international trade of the United States. In this instance, however, we are buyers and not sellers, as may readily be seen from the first of the tables below, in which is given, side by side, the annual quantities and values of the imports and exports since 1896. Our purchases last year were not quite so heavy as they were for the two previous years; nevertheless, the trade continues to be of very large proportions, as may be noted from the fact that our manufacturers have paid out annually for the past five years upward of $50,000,000 for the necessary supplies of these products. Hides and skins are, indeed, much the largest separate item in the whole list of our imports of animal products. This fact may be well illustrated by comparing the value of last year's imports with the value of all the animal imports, as shown on page ——, the totals being $53,280,944 for hides and skins and $101,007,543 for total animal products. The respective totals of 1902 were even closer than these; thus it appears that the value of the raw materials purchased from abroad for our tanneries exceeds that of all the other animal products combined.

The official returns show there are four main classes of hides and skins imported, namely, goatskins (not the Angora goat), hides of cattle, sheepskins, and calfskins. The goatskins, although second in point of quantity, are easily first in regard to value, the reverse being the case with hides of cattle, which are first in quantity and second in value. The two remaining classes, sheepskins and calfskins, are much less important than the goatskins and cattle hides, as may be seen from the Treasury returns of the fiscal year 1903, which are the most recent figures showing the quantity and value of each class imported for consumption in that year. The figures alluded to are as follows: Goatskins, 85,180,382 pounds; value, $24,926,329; hides of cattle, 120,738,049 pounds; value, $14,720,580; sheepskins, 43,277,321 pounds, with a valuation of $7,099,960, and calfskins, 34,074,137 pounds, valued at $5,837,878. The average unit values of the above were: Goatskins, 29 cents per pound; calfskins, 17 cents per pound; sheepskins, 16 cents per pound, and cattle hides, 12 cents per pound. It may be mentioned that under the present tariff laws all the foregoing are admitted free except hides of cattle, upon which there is a duty of 15 per cent ad valorem.

In regard to the sources of these imports, the returns give the hides in bulk only—that is, all the different classes are lumped together. They are shown to originate over a very wide area, large quantities coming from every continent on the globe except Africa, which supplies a very small quota only. The largest single contributor last year was Argentina, and far-away India was probably next largest,

these appearing in the report as South America, with a total quantity of 71,579,258 pounds, and East Indies, with 34,872,700 pounds; however, taken as a whole, the European supply was the greatest, as upward of 100,000,000 pounds came from the different countries of that continent. The remaining imports, which amounted to about one-fourth of the total of 289,001,032 pounds, were supplied by Canada, Mexico, and other Asia (except India) and Oceania.

In view of the necessity of supplementing our domestic supply of these products by such large importations as the foregoing, it naturally follows that exports of domestic hides and skins are exceedingly small in comparison with the imports. The exports of last year were, however, more than double those of 1902, the total sent out of the country in 1903 having been 21,251,307 pounds, valued at $2,078,414, while in 1902 the quantity and value were, respectively, 10,991,603 pounds and $1,025,157. One-third of the exports last year went over the border to Canada, and practically all the remainder were taken by Germany, United Kingdom, and Netherlands. It may be noted that the grade of hides which we export is inferior, as the average value works out to a little under 10 cents per pound; there no doubt is a better market at home for the higher grades.

The imports and exports of hides and skins (other than furs) since 1896 are shown in the first table below, and immediately following is a statement of the trade of 1903 in detail:

Imports and exports of hides and skins for the years 1896 to 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Calendar year.	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
1896	146,159,006	20,713,528	42,009,166	3,481,364
1897	236,372,088	33,230,749	18,778,031	1,553,622
1898	256,188,970	39,906,373	11,397,129	1,018,433
1899	318,261,631	51,127,659	7,514,483	769,927
1900	307,315,840	51,587,993	10,635,394	1,051,435
1901	310,539,594	55,565,388	8,736,495	869,961
1902	325,106,531	57,732,397	10,991,603	1,025,157
1903	289,001,032	53,280,944	21,251,307	2,078,414

The geographical distribution of the imports and exports for the year 1903 was as shown on the next page.

Quantity and value of imports and exports of hides and skins (other than furs) for the calendar year 1902.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Country from which imported or to which exported.	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
United Kingdom	29,369,920	4,911,201	3,298,943	321,218
Belgium	....	....	566,201	78,081
France	17,890,626	3,641,123	977,578	94,573
Germany	13,796,247	2,449,429	5,708,367	460,079
Netherlands	....	....	2,268,218	269,083
Other Europe	46,601,097	8,540,550	508,531	63,298
British North America	21,771,841	1,962,045	7,842,171	781,960
Central America	3,391,453	533,175	....	....
Mexico	18,037,952	8,298,968	26,233	3,566
West Indies and Bermuda	2,475,839	517,565	477	41
South America	71,579,258	12,992,523	....	....
Japan	....	....	1,300	123
East Indies	34,872,700	7,729,158	....	....
Other Asia and Oceania	25,703,323	5,983,871	15,896	2,052
Africa	3,510,776	721,336	....	....
Other countries	....	....	37,392	4,340
Total	289,001,032	53,280,944	21,251,307	2,078,414

The annual status of the imports of goatskins, morocco leather, and gloves (of leather) from 1896 to 1903 is as follows:

Statement of annual imports of goatskins, morocco leather, and gloves for the years 1896 to 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Calendar year.	Goatskins.		Morocco leather.	Gloves.
	Quantity.	Value.	Value.	Value.
	Pounds.	*Dollars.*	*Dollars.*	*Dollars.*
1896	38,882,234	8,803,609	2,808,322	5,618,311
1897	59,177,556	13,802,504	3,748,341	6,337,410
1898	65,546,570	16,854,430	2,452,655	5,686,464
1899	80,064,583	20,992,949	2,831,035	5,544,871
1900	69,104,372	19,008,097	2,940,949	6,433,941
1901	88,043,928	25,265,670	2,399,603	5,060,224
1902	83,115,160	24,171,569	2,037,556	5,135,590
1903	82,052,437	23,441,687	2,030,389	5,447,379

LEATHER AND LEATHER MANUFACTURES.

Our international commerce in the above products continued to be in a flourishing condition during the past year. The first of the tables below, which exhibits the annual imports and exports since 1896, shows that in respect to leather the trade balance that has all along been in our favor was more conspicuous than ever in 1903. In respect

to the manufactures, it will be seen that the balance was against us up to and including 1900, but since then it has been more and more in our favor. The total values of the imports of last year, both of leather and manufactures, remained much the same as they were in 1902, there being slight increases only in each case, but the exports, especially of manufactures, advanced in a pronounced degree. The imports of leather in 1903 were valued at $5,136,405 and the domestic exports at $23,697,409; the imports of leather manufactures in the same period totaled $6,571,344, while the exports were valued at $9,036,196. Thus the balance of trade in our favor last year was $18,561,004 for leather and $2,464,852 for leather manufactures.

IMPORTS.

Our importations of leather are almost entirely confined to the fancy kinds, particularly those produced from goatskins. The largest separate article of the imports is in the latter class, namely, skins for morocco. Nearly all the latter are brought in tanned, but unfinished, because of the fact that finished leathers have to pay at least double as much duty as the unfinished. The next largest item after morocco skins is upper leather, dressed and finished.

Almost all our imports of leather manufactures are composed of gloves. The total value last year of all manufactures other than gloves, including boots and shoes, harness and saddlery, and miscellaneous, was $1,123,965, while gloves alone cost $5,447,379. The great majority of the latter are women's gloves, the cheaper kinds of which are of sheep origin, while those of superior quality are of goat or kid. Considerably more of the cheaper, or sheepskin, gloves are imported than the others. The approximate average unit values of last year's importations were 35 cents per pair for the cheaper kinds and 55 cents per pair for those of goat origin. About four-fifths of all the gloves come from France and Germany, in about equal parts, and the total value of our purchases from each of these countries last year was a trifle over $2,000,000.

EXPORTS.

The exports of leather are divided into two classes, upper leather and sole leather, the bulk of the business being done with the former. There was some falling off in the shipments of sole leather last year, the total quantity having been 33,501,774 pounds, against 37,057,483 pounds for 1902. On the other hand, upper leather advanced considerably, the total value of the shipments increasing from $16,099,430 in 1902 to $17,376,746 last year. The United Kingdom is our big customer for the surplus product of our tanneries, about two-thirds of the upper leather and four-fifths of the sole leather going to British ports.

By far the greater part of our manufactured exports is made up of boots and shoes. The total value of each of the items of leather man-

ufactures for 1903 was as follows: Boots and shoes, $7,244,726; harness and saddlery, $533,996; all other, $1,247,474. A glance at the accompanying table will show that this branch of our trade has been making rapid and continuous improvement right along, the total value of the exports having almost quadrupled since 1896, the first year on the list. Our boots and shoes enter a large number of the world's markets, Great Britain being a good first among the receiving nations, the West Indies coming next, with Canada, Australia, and Mexico the most prominent of the remainder.

The annexed tables show, first, the total values of the imports and exports of leather and leather manufactures annually since 1896, and, second, the same in detail for the calendar year 1903:

Value of imports and exports of leather and leather manufactures for the years 1896 to 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

Calendar year.	Leather.		Leather manufactures.	
	Imports.	Exports.	Imports.	Exports.
1896	$5,104,571	$16,279,947	$6,103,713	$2,597,510
1897	6,373,726	16,321,849	6,789,576	2,904,819
1898	5,236,171	18,682,843	6,113,256	3,233,979
1899	5,750,937	22,104,451	6,143,380	4,705,382
1900	6,196,687	21,297,539	7,101,109	5,871,475
1901	5,507,377	21,776,362	5,868,628	7,173,087
1902	5,051,361	22,820,396	6,160,409	7,730,676
1903	5,136,405	23,697,409	6,571,344	9,036,196

Quantity and value of imports and exports of leather and leather manufactures for the calendar year 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

IMPORTS.

Article and country of import or export.	Quantity.	Value.
Leather:	*Pounds.*	*Dollars.*
Band or belting and sole leather		65,152
Calfskins, tanned, etc		890,685
Skins for morocco		2,030,389
Upper leather and skins, dressed, etc		2,150,179
Total leather		5,136,405
Leather manufactures:		
Gloves—		
Belgium		92,007
France		2,181,715
Germany		2,083,566
Other Europe		1,089,394
Other countries		697
Total		5,447,379
All other manufactures		1,123,965
Total manufactures		6,571,344

Quantity and value of imports and exports of leather, etc.—Continued.

EXPORTS.

Article and country of import or export.	Quantity.	Value.
Sole leather:	*Pounds.*	*Dollars.*
United Kingdom	27,914,399	5,098,254
Belgium	780,437	159,100
Germany	82,315	16,073
Italy	121,693	23,240
Netherlands	180,844	37,057
Other Europe	1,839,167	363,500
British North America	502,598	96,266
West Indies and Bermuda	28,263	6,238
South America	14,556	3,098
Japan	1,424,754	366,022
British Australasia	147,872	40,440
Philippine Islands	9,383	2,784
Other Asia and Oceania	147,774	37,945
British Africa	196,761	43,566
Other Africa	353	82
Other countries	110,605	26,998
Total	33,501,774	6,320,663
Upper and other leather:		
United Kingdom		11,072,694
Belgium		710,652
France		605,688
Germany		803,536
Italy		94,823
Netherlands		1,465,767
Other Europe		606,643
British North America		472,628
Central American States and British Honduras		79,973
Mexico		36,533
Cuba		116,494
Other West Indies and Bermuda		66,455
Argentina		92,147
Brazil		96,880
Chile		24,064
Colombia		38,443
Venezuela		54,667
Other South America		43,028
British Australasia		737,533
Philippine Islands		15,710
Other Asia and Oceania		63,340
British Africa		57,477
Other Africa		21,360
Other countries		211
Total		17,376,746
Total leather		23,697,409
Boots and shoes:		
United Kingdom		2,210,534
Belgium		38,676
France		99,954
Germany		388,986
Netherlands		11,864
Other Europe		55,998
British North America		744,290

Quantity and value of imports and exports of leather, etc.—Continued.

EXPORTS—Continued.

Article and country of import or export.	Quantity.	Value.
Boots and shoes—Continued.	*Pounds.*	*Dollars.*
Central American States and British Honduras		161,288
Mexico		689,331
West Indies and Bermuda		1,268,470
Colombia		143,768
Other South America		128,882
British Australasia		872,012
Philippine Islands		124,382
Other Asia aud Oceania		42,062
British Africa		244,855
Other Africa		17,328
Other countries		2,046
Total		7,244,726
Harness and saddlery		533,996
All other manufactures		1,247,474
Total manufactures		9,026,196

COMMERCE WITH OUR NONCONTIGUOUS TERRITORIES.

It may be interesting to notice the extent and growth of our domestic commerce with Alaska and the three principal island Territories—Hawaii, Philippine Islands, and Porto Pico. The series of tables which follows shows this trade in comparative form, contrasting the figures for 1903 with those of the year before. The returns, however, do not in all instances give the information required for the complete year, because in the cases in question the compilation of the data was not commenced until July 1, 1902. Wherever this occurs the trade for six months only is presented, and the comparison is made between the last six months of 1902 and the same period of 1903.

ALASKA.

Our commerce in animal products with Alaska compares very favorably in extent with that of any of the island Territories. The largest totals in the series are those of the shipments to Porto Rico. The Alaskan figures, however, are for six months, and if these are doubled they will be found to exceed those of Porto Rice for 1903, although somewhat less than the total for 1902. The total value of the shipments to Alaska for the last six months of 1903 was $926,542, that for the corresponding period of the previous year having been $846,340, thus showing a substantial growth in the past year. There were no strikingly large items in the list, which is mainly composed of food products. The largest single total in the table is that of butter, $128,340 worth having been shipped there the last six months of 1903, as against $104,834 worth for the similar period of 1902. Last year's butter averaged 26 cents a pound. There was quite a drop in the

shipments of eggs, although the amount was still large, $85,613. This sum also practically represents the value of the bacon and hams, and is not much below that of fresh beef. The eggs shipped in the last six months of the past year averaged the same price per dozen as the butter did per pound, namely, 26 cents. There were large increases in the shipments of live animals, particularly of horses, which went from 95, valued at $7,535, for the six months of 1902, to 264, valued at $28,457, for the same period of 1903:

Commerce of the United States in animals and animal products with Alaska for semi-annual periods of 1902 and 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

SHIPMENTS FROM UNITED STATES.

Article.	Last six months of 1902.		Last six months of 1903.	
	Quantity.	Value.	Quantity.	Value.
Animals:				
Cattle .... number..	361	$17,496	540	$18,606
Hogs .... do....	86	1,051	145	1,588
Horses .... do....	95	7,535	264	28,457
Mules .... do....	27	2,524	13	650
All other .... do....	....	17,449	....	35,255
Eggs .... dozens..	358,545	97,311	330,716	85,613
Boots and shoes .... pairs..	26,938	50,102	28,740	56,314
Other leather manufactures	....	8,484	....	13,804
Meats and meat products:				
Beef, canned .... pounds..	56,371	6,263	67,669	7,213
Beef, fresh .... do....	747,365	70,581	1,129,606	96,218
Beef, salted, etc .... do....	57,333	4,433	163,469	16,991
Pork, salted, etc .... do....	27,822	2,582	83,144	10,643
Bacon and hams .... do....	496,761	75,709	566,380	86,576
Lard .... do....	132,566	14,155	254,537	25,599
Tallow .... do....	8,032	517	3,200	143
All other meat products	....	109,869	....	70,623
Dairy products:				
Butter .... pounds..	442,529	104,834	495,549	128,340
Cheese .... do....	71,867	10,031	83,342	12,945
Milk	....	50,601	....	64,903
Wool manufactures:				
Carpets .... yards..	5,663	4,898	6,189	4,545
Flannels and blankets	....	4,296	....	4,925
Wearing apparel	....	109,016	....	120,167
All other	....	76,603	....	36,424
Total	....	846,340	....	926,542

SHIPMENTS TO UNITED STATES.

Animals:				
Cattle .... number..	1	$50	....	....
Horses .... do....	9	1,150	45	$6,650
All other	....	498	....	525
Eggs .... dozens..	900	256	855	192
Boots and shoes .... pairs..	1,285	2,324	320	740
Other leather manufactures	....	800	....	965

Commerce of the United States in animals and animal products, etc.—Continued.

SHIPMENTS TO UNITED STATES—Continued.

Article.	Last six months of 1902.		Last six months of 1903.	
	Quantity.	Value.	Quantity.	Value.
Meats and meat products:				
Beef, canned .... pounds..	320	$30	....	....
Beef, fresh .... do....	....	....	900	$90
Beef, salted, etc .... do....	1,578	100	....	....
Pork, salted, etc .... do....	....	....	450	25
Bacon and hams .... do....	1,437	230	70	13
Tallow .... do....	1,665	81	1,500	90
All other meat products	....	952	....	676
Dairy products:				
Butter .... pounds..	1,164	264	3,496	909
Cheese .... do....	110	19	175	32
Milk	....	130	....	126
Wool manufactures:				
Carpets .... yards..	20	25	....	....
Flannels and blankets	....	355	....	217
Wearing apparel	....	16,322	....	8,045
All other	....	251	....	360
Total	....	23,837	....	19,655

HAWAII.

The totals for the Hawaiian Islands are also for semiannual periods. They denote a steady trade, with a slight increase in 1903. The most important item in the Hawaiian table is boots and shoes. Of these there were 63,121 pairs exported in the last six months of 1902, and 73,478 pairs in the same period of 1903, which represents an increase at the rate of upward of 20,000 pairs for the year. It is a singular fact that an unusually large number of live hogs are shipped to Hawaii. The table shows there were 1,561 in the semiannual period of 1902 and 1,512 in the similar period last year. When it is considered that our entire exports of hogs for 1903 only amounted to 5,823, and that the number for 1902 was still smaller, it will be seen that the Hawaiian figures are quite remarkable.

Hawaii is the only one of our noncontiguous Territories that sends us any considerable quantity of animal products in return. The traffic in question is virtually confined to two items, namely, hides and skins (other than furs) and raw wool. A reference to the table will show that over 1,000,000 pounds of the former were received in the last six months of 1903, and that 265,605 pounds of raw wool came in during the same period.

Commerce of the United States in animals and animal products with Hawaii for semiannual periods of 1902 and 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

SHIPMENTS FROM UNITED STATES.

Article.	Last six months of 1902.		Last six months of 1903.	
	Quantity.	Value.	Quantity.	Value.
Animals:				
Cattle ....number..	27	$3,071	22	$1,630
Hogs ....do....	1,561	13,475	1,512	11,418
Horses ....do....	69	6,370	43	5,600
Mules ....do....	51	4,250	149	17,460
All other	....	2,479	....	2,249
Eggs ....dozens..	56,280	12,699	64,950	14,620
Boots and shoes ....pairs..	63,121	107,104	73,478	129,313
Other leather manufactures	....	52,476	....	57,790
Meats and meat products:				
Beef, canned ....pounds..	287,795	32,313	326,627	34,378
Beef, fresh ....do....	51,098	4,464	21,404	1,686
Beef, salted, etc ....do....	34,178	2,238	90,975	5,424
Pork, salted, etc ....do....	25,174	2,568	26,760	3,127
Bacon and hams ....do....	322,145	48,889	281,317	42,260
Lard ....do....	378,899	33,752	409,068	34,658
Tallow ....do....	....	....	477	29
All other meat products	....	68,032	....	58,756
Dairy products:				
Butter ....pounds..	184,252	49,782	182,240	47,970
Cheese ....do....	107,015	16,457	112,362	15,461
Milk	....	48,654	....	46,540
Wool manufactures:				
Carpets ....yards..	1,168	1,180	2,304	2,170
Flannels and blankets	....	7,969	....	10,530
Wearing apparel	....	53,791	....	58,889
All other	....	39,363	....	27,359
Total	....	611,376	....	629,317

SHIPMENTS TO UNITED STATES.

Article.	Quantity.	Value.	Quantity.	Value.
Animals:				
Cattle ....number..	1	$100	1	$250
Horses ....do....	6	3,850	9	2,050
All other	....	75	....	392
Hides and skins (other than furs) ....pounds..	840,540	77,853	1,013,505	82,509
Boots and shoes ....pairs..	928	1,606	1,318	2,467
Other leather manufactures	....	2,153	....	2,587
Meats and meat products:				
Beef, canned ....pounds..	456	44	320	35
Bacon and hams ....do....	....	....	2,980	355
Lard ....do....	4,320	310	380	39
Tallow ....do....	61,508	2,833	196,741	8,316
All other meat products	....	1,524	....	35
Dairy products:				
Cheese ....pounds..	90	21	1,025	152
Milk	....	1,140	....	137
Wool and manufactures of:				
Wool, raw ....pounds..	274,705	32,708	265,605	33,649

Commerce of the United States in animals and animal products, etc.—Continued.

SHIPMENTS TO UNITED STATES—Continued.

Article.	Last six months of 1902.		Last six months of 1903.	
	Quantity.	Value.	Quantity.	Value.
Wool and manufactures of—Continued.				
Carpets .... yards..	112	$213	1,178	$2,565
Flannels and blankets	....	71	....	142
Wearing apparel	....	4,867	....	10,100
All other	....	317	....	2,577
Total	....	129,685	....	148,357

PHILIPPINE ISLANDS.

The traffic in animal products with our most distant territory made a rapid advance during the past year, the accompanying table showing the total value to have been $576,506, as against $327,311 for 1902. Our leather manufacturers have been unusually active in this market, with the result that they have almost half of the entire trade. The boots and shoes exported last year totaled 70,376 pairs, which were valued at $124,382; other manufactures of leather amounted to a still greater valuation—$140,575. The most important food items, in the order of magnitude, were milk (necessarily of the condensed variety), the total value of which was $126,961; bacon and hams, valued at $52,261; meat products not specified, valued at $49,533; canned beef, with a valuation of $37,074, and lard, which was valued at $22,981. With the exception of canned beef and lard, all the above items show striking advances on the figures of the previous year; the decrease in lard was very slight, but the drop in canned beef was unaccountably large, the valuation for last year having been less than half the total for 1902.

Commerce of the United States in animals and animal products with the Philippine Islands for the calendar years 1902 and 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

SHIPMENTS FROM UNITED STATES.

Article.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
Animals	....	$110	....	$2,598
Boots and shoes .... pairs..	39,485	77,038	70,376	124,382
Other leather manufactures	....	57,136	....	140,575
Meats and meat products:				
Beef, canned .... pounds..	717,921	78,445	347,301	37,074
Beef, salted, etc .... do....	10,900	729	1,710	85
Pork, salted, etc .... do....	11,400	1,072	44,850	4,526
Bacon and hams .... do....	228,065	29,232	347,573	52,261

Commerce of the United States in animals and animal products, etc.—Continued.

SHIPMENTS FROM UNITED STATES—Continued.

Article.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.
Meats and meat products—Continued.				
Lard ....pounds..	240,679	$23,390	224,829	$22,981
Tallow ....do....	1,809	122	....	....
All other meat products	....	16,591	....	49,533
Dairy products:				
Butter....pounds..	6,623	1,193	30	10
Cheese ....do....	11,339	1,493	7,287	1,143
Milk	....	25,709	....	126,961
Wool manufactures:				
Flannels and blankets....	....	....	....	842
Wearing apparel	....	14,823	....	10,548
All other....	....	228	....	2,987
Total	....	327,311	....	576,506

SHIPMENTS TO UNITED STATES.

Article.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.
Bones, horns, etc	....	$42	....	$7
Wool manufactures....	....	72	....	37
Total	....	114	....	44

PORTO RICO.

There was a slight decrease in our trade with Porto Rico last year, the table showing a total of $1,881,712 for the shipments of 1902, while those of 1903 were valued at $1,789,427. Notwithstanding this the majority of the articles on the list had larger totals last year than for 1902. The decrease in the grand total is accounted for by the unusually large falling off in one item, namely, lard. There were 5,798,534 pounds of the latter exported to Porto Rico in 1902, while last year the quantity was only 2,419,138 pounds—a drop of over 50 per cent. The Porto Ricans seem to have a preference for our pork products, as the three items comprising this trade amount to close upon half the entire shipments. The most important of the products mentioned and at the same time the largest single item in the table is salt pork, of which 4,555,297 pounds were shipped last year, valued at $395,363. Lard came next, with a valuation of $198,870, closely followed by bacon and hams which totaled $192,679. Boots and shoes is the third largest item on the list, the number of pairs shipped last year having been 235,662 and the value $215,336, these figures being a little less than those for the previous year; but "Other leather manufactures" increased from $70,313 to $84,513. Of the dairy products butter increased sharply, as did also milk, while cheese fell off from 993,715 pounds to 763,754 pounds.

In the shipments from Porto Rico to the United States it will be seen there is one item only which is of any size, that is, hides and skins. We received of these in 1903, 535,610 pounds, valued at $66,491.

Commerce of the United States in animals and animal products with Porto Rico for the calendar years 1902 and 1903.

[Compiled from reports of the Bureau of Statistics, Department of Commerce and Labor.]

SHIPMENTS FROM UNITED STATES.

Article.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
Animals:				
Cattle ....number..			2	$131
Hogs ....do....	29	$266	3	15
Horses ....do....	3	650	6	1,725
Mules ....do....	20	3,300	3	450
All other ....do....		309		289
Eggs ....dozens..	6,460	1,614	9,018	1,794
Boots and shoes ....pairs..	247,119	238,275	235,662	215,336
Other leather manufactures		70,313		84,513
Meats and meat products:				
Beef, canned ....pounds..	57,201	5,630	53,698	5,292
Beef, fresh ....do....	290,868	32,779	300,572	33,150
Beef, salted, etc ....do....	303,683	16,894	181,655	12,232
Pork, salted, etc ....do....	4,048,150	365,276	4,555,297	395,363
Bacon and hams ....do....	1,795,963	181,070	1,926,994	192,679
Lard ....do....	5,798,534	552,429	2,419,138	198,870
Tallow ....do....	107,742	6,459	4,931	362
All other meat products		110,017		373,930
Dairy products:				
Butter ....pounds..	329,760	55,827	433,881	77,407
Cheese ....do....	993,715	116,634	763,754	98,662
Milk		12,125		15,687
Wool manufactures:				
Carpets ....yards..	380	319	3,997	3,018
Flannels and blankets				7,873
Wearing apparel		78,003		34,810
All other		33,523		35,938
Total		1,881,712		1,789,427

SHIPMENTS TO UNITED STATES.

Horses ....number..	7	$405	10	$800
Bones, hoofs, etc		3,131		1,554
Hides and skins (other than furs) ....pounds..	682,910	78,881	535,610	66,491
Tallow ....do....	64,362	3,057	32,088	1,441
Total		85,474		70,286

FARM ANIMALS IN 1903.

NUMBER AND VALUE OF FARM ANIMALS.

Number, average price, and total value of farm animals in the United States in 1903.

[From Bureau of Statistics, Department of Agriculture.]

States and Territories.	Horses.			Mules.			Milch cows.		
	Number.	Average price per head.	Value.	Number.	Average price per head.	Value.	Number.	Average price per head.	Value.
Maine	123,773	$85.43	$10,573,812				185,417	$29.91	$5,545,822
New Hampshire	64,268	79.96	5,138,899				124,904	31.01	3,873,273
Vermont	88,247	81.42	7,184,807				288,197	26.32	7,585,345
Massachusetts	140,332	88.04	12,354,201				188,740	40.40	7,625,096
Rhode Island	15,923	95.00	1,512,649				25,723	40.10	1,031,492
Connecticut	57,428	83.91	4,819,022				129,567	39.50	5,117,896
New York	631,287	93.76	59,186,681	3,825	$92.39	$353,382	1,655,328	35.49	58,747,591
New Jersey	95,230	99.28	9,454,882	5,024	98.21	493,413	179,241	39.04	6,997,569
Pennsylvania	595,594	89.64	53,391,436	37,776	93.36	3,526,759	1,055,071	34.08	35,956,820
Delaware	34,742	80.06	2,781,538	5,334	95.68	510,380	34,779	33.91	1,179,356
Maryland	142,260	76.61	10,897,856	17,901	97.62	1,747,410	148,912	29.63	4,412,263
Virginia	259,907	68.97	17,926,388	41,599	86.16	3,583,996	255,280	24.76	6,320,733
North Carolina	160,814	81.06	13,035,058	139,428	95.65	13,336,658	197,431	22.36	4,414,557
South Carolina	73,991	84.64	6,262,562	105,537	99.59	10,510,088	110,812	24.48	2,712,678
Georgia	121,922	94.94	11,575,478	195,204	104.02	20,305,732	280,096	22.68	6,352,577
Florida	45,589	68.97	3,144,392	15,118	97.08	1,467,672	86,149	23.38	2,014,164
Alabama	146,291	62.79	9,185,063	156,892	85.50	13,414,873	232,444	19.57	4,548,929
Mississippi	247,280	64.71	16,002,539	211,444	84.08	17,777,623	269,311	22.38	6,027,180
Louisiana	181,255	57.24	10,375,510	134,876	88.17	11,891,393	168,000	24.39	4,097,520
Texas	1,252,714	35.16	44,047,429	399,018	55.09	21,983,352	821,991	19.66	16,160,343
Arkansas	243,672	54.27	13,225,095	160,106	74.82	11,979,477	278,082	18.39	5,113,928
Tennessee	277,884	69.97	19,444,012	170,824	81.86	13,984,310	285,383	22.23	6,344,064
West Virginia	170,737	70.14	11,975,475	9,988	71.08	709,992	182,201	28.66	5,221,881
Kentucky	359,411	69.34	24,921,020	141,624	79.26	11,225,763	295,584	25.05	7,404,379
Ohio	801,932	83.96	67,335,165	16,291	80.84	1,316,983	782,866	33.17	25,967,665
Michigan	548,015	88.57	48,538,005	2,686	62.61	168,159	550,643	32.79	18,055,584
Indiana	642,567	80.12	51,482,058	56,309	82.24	4,630,902	553,115	30.57	16,908,726
Illinois	1,120,276	80.60	90,297,838	110,930	78.38	8,694,882	1,005,484	33.81	33,995,414
Wisconsin	545,725	85.50	46,658,534	4,796	77.47	371,534	1,063,944	31.00	32,982,264
Minnesota	675,202	74.56	50,343,952	8,164	72.21	589,537	820,439	25.45	20,880,173
Iowa	1,156,016	72.41	83,712,676	44,996	72.00	3,239,722	1,363,094	29.09	39,652,404
Missouri	801,868	67.46	54,093,772	202,888	77.44	15,710,951	581,415	26.04	15,140,047
Kansas	871,908	63.34	55,226,565	90,773	71.41	6,481,783	699,246	24.91	17,418,218
Nebraska	779,953	60.00	46,795,623	47,182	70.99	3,349,436	649,839	26.53	17,240,229
South Dakota	458,096	56.66	25,955,764	6,893	61.79	425,940	386,253	24.93	9,629,287
North Dakota	369,533	67.93	25,101,324	7,102	79.12	561,919	183,332	28.89	5,296,461
Montana	244,104	36.82	8,988,890	3,390	47.66	161,552	53,951	36.20	1,953,026
Wyoming	104,368	25.73	2,685,679	1,466	59.51	87,243	19,391	32.96	639,127
Colorado	203,283	41.92	8,521,713	9,098	57.61	524,099	121,775	30.06	3,660,556

Number, average price, and total value of farm animals, etc.—Continued.

States and Territories.	Horses.			Mules.			Milch cows.		
	Number.	Average price per head.	Value.	Number.	Average price per head.	Value.	Number.	Average price per head.	Value.
New Mexico	115,932	$17.52	$2,031,649	5,047	$34.81	$175,673	19,590	$31.30	$613,167
Arizona	108,781	26.83	2,918,733	3,701	47.76	176,751	18,856	35.91	677,119
Utah	105,309	42.98	4,525,673	2,044	36.44	74,485	69,496	30.93	2,149,511
Nevada	79,812	46.03	3,674,072	2,217	49.75	110,303	16,170	36.62	592,145
Idaho	142,348	37.61	5,353,451	1,551	49.41	76,635	57,327	31.28	1,793,189
Washington	221,328	66.72	14,766,354	2,319	60.67	140,704	154,454	33.41	5,160,308
Oregon	212,888	51.30	10,921,551	6,944	51.67	358,824	136,199	30.06	4,094,142
California	367,009	65.66	24,099,139	67,031	72.68	4,871,487	344,232	38.55	13,270,144
Oklahoma	344,637	49.93	17,207,124	61,185	63.50	3,885,388	188,616	21.05	3,970,367
Indian Territory	184,618	39.48	7,289,190	41,395	61.50	2,545,667	101,447	22.64	2,296,760
United States	16,736,059	67.93	1,136,940,298	2,757,916	78.88	217,532,832	17,419,817	29.21	508,841,489

States and Territories.	Other cattle.			Sheep.			Hogs.		
	Number.	Average price per head.	Value.	Number.	Average price per head.	Value.	Number.	Average price per head.	Value.
Maine	122,440	$15.74	$1,926,643	313,982	$2.84	$893,153	65,355	$8.76	$572,510
New Hampshire	102,210	15.33	1,566,520	82,605	2.83	233,392	49,723	10.40	517,119
Vermont	223,634	13.73	3,070,176	246,488	2.83	697,117	89,510	9.06	810,961
Massachusetts	94,334	17.11	1,614,356	44,855	4.27	191,424	70,510	9.46	667,025
Rhode Island	10,549	19.25	203,026	8,834	3.69	32,576	12,203	13.08	159,615
Connecticut	86,609	20.37	1,764,493	34,254	4.54	155,532	46,501	11.92	554,292
New York	936,300	18.08	16,924,184	1,313,974	3.84	5,042,638	682,437	9.52	6,496,800
New Jersey	82,061	20.33	1,668,489	44,685	4.08	182,439	154,069	11.35	1,748,683
Pennsylvania	798,449	21.83	17,431,341	963,421	3.53	3,402,129	1,000,082	9.03	9,030,740
Delaware	21,390	17.61	376,622	11,946	4.03	48,199	44,681	8.20	366,384
Maryland	132,652	18.49	2,452,653	163,564	3.64	594,686	293,257	7.65	2,243,416
Virginia	436,189	17.04	7,431,780	572,314	2.98	1,705,611	759,567	5.00	3,797,835
North Carolina	298,539	10.74	3,206,759	203,027	1.98	401,425	1,047,669	4.84	5,070,718
South Carolina	176,603	11.17	1,972,444	59,452	1.97	117,311	651,870	5.64	3,676,547
Georgia	635,494	11.36	7,219,407	276,660	1.72	476,298	1,411,032	5.25	7,407,918
Florida	522,526	9.09	4,749,132	110,955	2.15	238,909	387,617	3.48	1,348,907
Alabama	379,353	7.70	2,922,797	195,773	1.83	358,500	1,013,816	4.34	4,399,961
Mississippi	423,132	9.60	4,060,881	187,489	1.68	314,907	1,045,942	4.99	5,219,251
Louisiana	404,945	10.29	4,168,908	176,655	1.89	333,012	649,372	4.93	3,201,404
Texas	8,087,989	10.13	81,928,093	1,667,139	1.97	3,285,431	2,404,808	5.19	12,480,954
Arkansas	468,964	7.65	3,587,246	198,704	1.65	327,027	1,074,214	4.08	4,382,793
Tennessee	433,557	11.43	4,954,470	300,378	2.24	671,584	1,053,663	4.79	5,047,046
West Virginia	345,209	20.64	7,123,727	648,951	3.08	1,995,784	312,713	5.46	1,707,413
Kentucky	488,561	16.64	8,131,271	719,779	2.71	1,948,441	948,509	4.27	4,050,133
Ohio	1,154,323	21.37	24,666,963	3,171,963	3.20	10,158,528	2,728,535	6.25	17,053,344
Michigan	729,077	16.71	12,180,406	2,120,090	3.14	6,659,415	979,199	7.34	7,187,321
Indiana	895,583	21.13	18,919,826	1,233,447	3.45	4,249,472	2,658,051	6.17	16,400,175
Illinois	1,683,709	24.78	41,714,062	820,184	3.55	2,910,751	3,710,020	6.82	25,302,336
Wisconsin	1,137,211	14.59	16,593,165	1,355,341	2.94	3,981,721	1,670,016	7.76	12,959,324
Minnesota	932,481	11.41	10,636,253	513,337	2.61	1,340,631	1,219,770	7.16	8,733,553
Iowa	3,502,532	22.10	77,395,457	862,118	3.31	2,856,886	7,364,268	6.39	47,057,673
Missouri	1,419,132	19.40	27,525,913	778,121	2.90	2,254,683	3,142,002	5.30	16,652,611
Kansas	2,604,174	18.90	49,228,000	263,219	2.97	781,312	1,856,935	6.53	12,125,786

Number, average price, and total value of farm animals, etc.—Continued.

States and Territories.	Other cattle.			Sheep.			Hogs.		
	Number.	Average price per head.	Value.	Number.	Average price per head.	Value.	Number.	Average price per head.	Value.
Nebraska	2,355,919	$17.48	$41,184,298	493,340	$2.79	$1,376,664	2,860,242	$6.43	$18,391,356
South Dakota	1,485,417	18.19	27,013,343	927,246	2.71	2,509,221	820,416	6.73	5,521,400
North Dakota	610,923	17.55	10,719,863	836,059	2.69	2,252,008	184,173	7.79	1,434,708
Montana	1,059,045	19.42	20,563,797	5,270,063	2.31	12,184,386	54,850	9.06	496,941
Wyoming	804,021	19.60	15,760,416	4,602,658	2.58	11,883,603	15,823	7.96	125,951
Colorado	1,260,574	16.45	20,733,666	1,846,518	2.25	4,152,265	74,382	7.56	562,328
New Mexico	916,095	14.55	13,330,466	3,860,466	1.93	7,464,598	22,238	7.90	175,680
Arizona	556,841	17.30	9,633,401	1,088,188	2.18	2,375,841	18,368	7.29	133,903
Utah	251,783	17.39	4,378,504	2,391,947	2.29	5,468,230	56,818	8.20	465,908
Nevada	382,373	22.34	8,541,141	879,602	2.48	2,185,283	14,300	7.79	111,397
Idaho	351,226	17.97	6,310,761	3,588,034	2.21	7,913,050	116,023	6.37	739,067
Washington	297,513	19.08	5,676,810	894,335	2.78	2,490,633	179,513	7.98	1,432,514
Oregon	575,744	16.25	9,354,628	2,927,198	2.04	5,976,461	274,421	5.75	1,577,921
California	1,089,532	21.98	23,944,214	2,271,249	2.75	6,237,758	526,650	6.55	3,449,558
Oklahoma	1,351,999	14.06	19,011,943	64,242	2.58	165,686	491,429	5.84	2,869,945
Indian Territory	510,582	13.13	6,705,420	25,295	2.11	53,488	701,805	4.71	3,305,502
United States	43,629,498	16.32	712,178,134	51,630,144	2.59	133,530,099	47,009,367	6.15	289,224,627

LOSS OF FARM ANIMALS.

Estimated losses of farm animals during the year ended March 31, 1904.

[From Bureau of Statistics, Department of Agriculture.]

States and Territories.	Horses. Estimated losses from disease.		Cattle. Estimated losses.			Sheep. Estimated losses.			Hogs. Estimated losses from disease.	
	Per cent.	Number.	From exposure.	From disease.	From all causes.	From exposure.	From disease.	From all causes.	Per cent.	Number.
			Per ct.	*Per ct.*	*Number.*	*Per ct.*	*Per ct.*	*Number.*		
Maine	1.1	1,362	......	0.8	2,463	0.2	2.2	7,536	1.0	654
New Hampshire	1.4	900	0.7	1.4	4,770	1.6	3.7	4,378	1.5	746
Vermont	1.4	1,235	.5	2.9	17,402	1.1	2.5	8,873	1.5	1,343
Massachusetts	1.6	2,245	.4	1.9	6,510	......	1.0	449	2.3	1,622
Rhode Island	2.3	366	......	2.1	762	......	1.2	106	2.5	305
Connecticut	2.2	1,263	.1	1.8	4,107	.5	3.0	1,199	2.8	1,302
New York	1.8	11,363	.7	1.9	67,382	.9	1.7	34,164	3.3	22,520
New Jersey	2.3	2,190	.4	2.3	7,055	.7	1.9	1,162	3.2	4,930
Pennsylvania	1.9	11,316	.4	2.0	44,484	1.2	2.8	38,537	2.7	27,002
Delaware	1.8	625	2.8	2.9	3,202	1.4	3.4	573	10.1	4,513
Maryland	1.7	2,418	1.1	1.3	6,757	1.9	2.2	6,706	3.1	9,091
Virginia	2.0	5,198	1.5	2.1	24,893	2.4	3.3	32,622	5.5	41,776
North Carolina	2.2	3,538	2.2	2.3	22,318	3.1	3.1	12,588	9.6	100,576
South Carolina	3.6	2,664	3.4	2.9	18,107	3.9	3.5	4,400	7.5	48,890
Georgia	3.5	4,267	5.3	3.1	76,909	6.3	5.1	31,540	8.9	125,582
Florida	4.3	1,960	6.3	4.2	63,911	4.8	3.2	8,877	7.2	27,908
Alabama	2.5	3,657	2.7	2.9	34,261	3.6	6.1	18,990	8.2	83,133
Mississippi	2.8	6,924	2.6	3.0	38,777	4.4	3.9	15,562	8.1	84,721

Estimated losses of farm animals during the year ended March 31, 1904—Continued.

States and Territories.	Horses. Estimated losses from disease.		Cattle. Estimated losses.			Sheep. Estimated losses.			Hogs. Estimated losses from disease.	
	Per cent.	Number.	From exposure.	From disease.	From all causes.	From exposure.	From disease.	From all causes.	Per cent.	Number.
			Per ct.	*Per ct.*	*Number.*	*Per ct.*	*Per ct.*	*Number.*		
Louisiana	3.1	5,619	4.1	3.1	41,252	3.6	4.9	15,016	8.5	55,197
Texas	2.6	32,571	2.9	3.2	543,508	2.7	2.3	83,357	3.7	88,978
Arkansas	2.8	6,823	3.3	3.6	51,547	3.0	3.1	12,121	10.8	116,015
Tennessee	1.9	5,280	2.1	2.7	34,509	3.2	3.4	19,825	7.9	83,239
West Virginia	1.7	2,903	1.4	1.8	16,877	2.2	3.4	36,341	3.5	10,945
Kentucky	1.8	6,469	1.7	2.0	29,013	2.7	3.5	44,626	7.1	67,344
Ohio	1.5	12,029	.7	1.4	40,681	1.9	2.4	136,394	5.0	136,427
Michigan	1.8	9,864	.8	1.5	29,434	1.4	3.5	103,884	3.7	36,230
Indiana	1.9	12,209	.6	1.8	34,769	1.6	3.2	59,205	7.8	207,328
Illinois	1.5	16,804	.7	1.6	61,851	1.0	2.3	27,066	5.8	215,181
Wisconsin	1.7	9,277	.7	1.5	48,425	1.1	2.7	51,503	2.7	45,090
Minnesota	2.0	13,504	1.3	2.1	59,599	1.4	2.7	21,047	3.0	36,593
Iowa	1.5	17,340	.8	2.0	136,238	1.2	2.6	32,760	5.5	405,035
Missouri	1.8	14,434	1.1	2.5	72,020	1.8	3.2	38,906	7.7	241,934
Kansas	1.3	11,335	.9	1.8	89,193	.6	1.2	4,738	3.9	72,420
Nebraska	1.6	12,479	1.3	2.6	117,225	1.8	2.7	22,200	5.7	163,034
South Dakota	1.6	7,330	3.3	2.2	102,942	2.7	2.4	47,290	5.4	44,302
North Dakota	2.4	8,869	6.1	3.4	75,455	12.3	3.8	134,605	2.4	4,420
Montana	1.7	4,150	5.4	1.7	79,023	7.8	1.8	505,926	.9	494
Wyoming	1.8	1,879	2.3	3.0	43,640	4.1	2.0	280,762	3.4	538
Colorado	1.9	3,862	2.3	2.4	64,970	3.2	3.2	118,178	1.5	1,116
New Mexico	2.7	3,130	3.0	2.6	52,399	2.8	2.4	200,744	.8	178
Arizona	10.3	11,204	7.0	4.7	67,357	5.3	3.3	93,584	5.3	974
Utah	1.6	1,685	2.6	1.4	12,851	4.5	2.2	160,261	1.0	568
Nevada	4.8	3,831	4.4	3.8	32,681	4.9	4.8	85,321	1.8	257
Idaho	1.7	2,420	2.9	1.8	19,202	5.0	2.5	269,103	2.8	3,249
Washington	2.2	4,869	2.8	1.7	20,338	5.3	2.3	67,970	2.0	3,590
Oregon	1.8	3,832	4.3	1.6	42,005	4.4	2.3	196,123	1.3	3,567
California	2.0	7,340	4.4	3.3	110,400	5.2	3.0	186,242	4.5	23,699
Oklahoma	1.7	5,859	2.0	2.5	69,327	5.3	2.0	4,690	2.4	11,794
Indian Territory	3.0	5,539	3.0	2.5	33,662	2.3	3.7	1,518	7.8	54,741
United States	2.0	328,230	2.0	2.4	2,676,463	3.8	2.6	3,289,568	5.8	2,721,091

LIVE-STOCK ASSOCIATIONS AND THE MARKETS.

REGISTERED LIVE STOCK IN THE UNITED STATES, DECEMBER 31,1903.

A census of improved live stock has been frequently suggested as an interesting field for the statistician and has been occasionally attempted by the authorities of the United States Census without much success. Inquiries frequently come to the Bureau of Animal Industry regarding the number of registered domestic animals in the country, and to secure data on which to base estimates for replies to such questions a circular letter was addressed to the secretaries of the pedigree record associations certified by the Department of Agriculture, asking them to submit estimates of the number of males and females recorded in their books which were living on December 31, 1903. Their replies are embodied in the table at the close of this article, with some figures from the latest published volumes of books of records in cases of breeds whose associations failed to respond. It is unfortunate that no replies were received in several instances.

Using the figures submitted as a basis, and making allowances[a] for associations and breeds from which reports were not received or were not complete, the proportion of domestic animals in the country which are registered is approximately estimated as follows:

	Per cent.
Horses	0.94
Dairy cattle	[b]2.00
Beef ("other") cattle	.84
Sheep	.47
Hogs	.29

In general terms we may say that the proportions of the various classes of domestic animals which are registered approach 2 per cent for dairy cattle, 1 per cent in the case of horses and beef cattle, 0.5 per cent in sheep, and 0.3 per cent in hogs. In the Eastern States

[a] Horses allowed, 95,000; beef cattle, 15,000; sheep, 70,000, and hogs, 20,000. These estimates were made by taking the sum of registered animals for which estimates were not made and estimating the number of living animals as approximately one-half of the total number registered in case of horses and beef cattle and one-fourth in that of sheep and hogs. It will be noticed that this is rather smaller than the estimates generally furnished by the secretaries. In estimating the number of registered beef cattle this term was used to include all breeds but the Ayrshire, Dutch-Belted, Guernsey, Holstein-Friesion, and Jersey.

[b] Estimate of Maj. H. E. Alvord. See B. A. I. Bul. No. 55, p. 13.

and the corn belt the actual percentages doubtless exceed these considerably. In these sections and in some parts of the range there are also many cases where animals are practically purebred though not eligible to record for various reasons, and there are comparatively few farms in these localities on which some evidence of improved blood may not be seen.

Using the proportions in the table, we find from the figures of the Twelfth Census the following as the approximate number of registered animals living on December 31, 1903:

	Number.
Horses	180,000
Dairy cattle	340,000
Beef ("other") cattle	500,000
Sheep	300,000
Hogs	190,000

These figures are of but little statistical value, but they have some interest for the stock breeder in that they show the really small number of animals which can be drawn upon for breeding purposes. The grades of the different breeds are not considered in the above figures.

The acknowledgements of the Bureau are due those secretaries who furnished estimates.

Registered live stock in the United States on December 31, 1903.

[Mainly compiled from estimates and statements furnished by the secretaries of the pedigree record associations.]

Breed.	Book of record.	Animals registered Dec. 31, 1903.			Registered animals living Dec. 31, 1903.		
		Male.	Female.	Total.	Male.	Female.	Total.
HORSES.		*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
American Trotter	American Trotting Register	39,000	a125,000	a164,000	No accurate data.		
Morgan	American Morgan Register			5,000	2,300	900	3,200
American Saddle Horse	American Saddle Horse Register	a2,077	2,727	a4,804	1,038	1,363	2,401
Thoroughbred	American Studbook						25,000
Cleveland Bay	American Cleveland Bay Studbook	1,173	455	1,628	1,173	455	1,628
German Coach	German, Hanoverian, and Oldenburg Coach Horse Studbook	1,126	141	1,267			1,000
German Coach (Oldenburg)	Oldenburg Coach Horse Register			224	No accurate data.		
Hackney	American Hackney Studbook	1,000	2,000	3,000	826	1,483	2,309
Shetland Pony	American Shetland Pony Club Studbook			5,200	1,500	2,200	3,700
Belgian Draft	American Register of Belgian Draft Horses			1,765	1,556	209	1,765
Clydesdale	American Clydesdale Studbook			b11,000			
French Draft	National Register of French Draft Horses			13,018	No accurate data.		
Percheron	American Percheron Studbook			37,000	18,000	11,000	29,000
Shire	American Shire Horse Studbook			7,406	4,155	1,650	5,805
Suffolk	American Suffolk Horse Studbook			200	90	40	130
ASSES.							
Jacks and Jennies	American Jack Stock Studbook	700	650	1,350	No accurate data.		
CATTLE.							
Aberdeen-Angus	American Aberdeen-Angus Herdbook			65,955	20,520	30,780	51,300
Galloway	American Galloway Herdbook			23,700	4,840	6,160	11,000
Hereford	American Hereford Record			178,225	47,000	55,000	102,000
Shorthorn	American Shorthorn Herdbook			557,000	71,000	152,000	223,000
Sussex	American Sussex Register			226	25	100	125
Brown Swiss (Schwytz)	Swiss Record			4,546	886	1,350	2,236

a Includes geldings. b Registrations to close of Vol. XI, 1904.

Registered live stock in the United States on December 31, 1903—Continued.

Breed.	Book of record.	Animals registered Dec. 31, 1903.			Registered animals living Dec. 31, 1903.		
		Male.	Female.	Total.	Male.	Female.	Total.
CATTLE—continued.		*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
Devon	American Devon Record	7,816	13,255	21,071	5,210	8,836	14,046
Polled Durham	American Polled Durham Herdbook			7,000	3,000	3,000	6,000
Red polled	Red Polled Herdbook	12,420	22,238	34,658	No accurate data.		
Ayrshire	Ayrshire Record			28,141	3,000	7,000	10,000
Dutch-Belted	Dutch Belted Cattle Herdbook			1,653			600
Guernsey	Herd Register of the American Guernsey Cattle Club			26,051	6,000	10,000	16,000
Holstein-Friesian	Holstein-Friesian Herdbook			124,691	7,529	23,716	31,245
Jersey	Herd Register of the American Jersey Cattle Club			245,743	No accurate data.		
SHEEP.							
Merino (Delaine)	Dickinson Spanish Merino Sheep Register			9,000	No accurate data.		
Do	Improved Delaine Merino Register			18,400			
Do	National Delaine Merino Register			17,677	1,000	3,000	4,000
Do	Standard Delaine Merino Register				9,000	13,000	22,000
Merino (French)	American Rambouillet Record			27,834	8,000	12,000	20,000
Merino (Spanish)	Register of the Michigan Merino Sheep Breeders' Association			60,000	6,000	14,000	20,000
Do	Register of the National Merino Sheep Breeders' Association			28,374	1,000	2,000	3,000
Do	Register of the New York State American Merino Sheep Breeders' Association.			19,500	250	1,750	2,000
Do	Register of the Vermont Merino Sheep Breeders' Association	105,000	105,000	210,000			
Cheviot	Flock Book of the National Cheviot Sheep Society			a 2,476			
Dorset Horn	Flock Book of the Continental Dorset Club	1,025	2,529	3,454	No accurate data.		
Do	Flock Record of the Dorset Horn Sheep Breeders' Association of America			10,248	2,000	8,000	10,000
Hampshire Down	Hampshire Down Flock Record			151,133	2,500	7,500	10,000
Oxford Down	American Oxford Record			30,543	No accurate data.		
Shropshire	American Shropshire Sheep Record			201,500	36,500	49,500	86,000
Southdown	American Southdown Record			17,673	2,627	6,188	8,815

Suffolk	Register of the American Suffolk Flock Registry Association	....	....	749	250	400	650
Cotswold	American Cotswold Record	....	....	30,000	....	....	18,000
Liecester	American Liecester Record	....	....	7,352	2,335	3,840	6,175
Lincoln	Register of the National Lincoln Sheep Breeders' Association	....	....	11,776	3,600	5,193	8,793
HOGS.							
Berkshire	American Berkshire Record	....	....	74,040	8,743	16,257	25,000
Cheshire	Cheshire Herdbook	....	....	3,200	200	500	700
Chester White	American Chester White Record	....	....	11,911	489	1,307	1,796
Do	Chester White Record	[b] 6,002	[b] 13,629	[b] 19,631	....	....	....
Chester, Ohio Improved	Ohio Improved Chester Record	....	....	20,000	4,250	12,250	16,500
Duroc Jersey	American Duroc Jersey Record	....	....	20,840	No accurate data.		
Do	National Duroc Jersey Record	....	....	42,500	....	....	20,000
Essex	American Essex Record	....	....	2,796	1,105	1,691	2,796
Poland China	American Poland-China Record	....	....	145,700	12,000	28,000	40,000
Do	Central Poland-China Record	[c] 12,025	[c] 26,659	[c] 38,684	....	....	....
Do	Ohio Poland-China Record	28,000	65,000	93,000	7,000	16,000	23,000
Do	Southwestern Poland-China Record	....	....	1,233	250	500	750
Do	Standard Poland-China Record	30,012	71,246	101,258	10,000	23,000	33,000
Victoria	Record of the Victoria Swine Breeders' Association	437	1,326	1,763	....	....	1,200
Tamworth	Record of the American Tamworth Swine Record Association	....	....	[d] 1,000	....	....	....
Yorkshire, Large Improved	Register of the American Yorkshire Club	....	....	4,900	....	....	....

[a] Vol. III, 1901. [b] Vol. IX, 1902. [c] XXIV, 1903. [d] Vol. I, part 1, 1903.

PEDIGREE RECORD ASSOCIATIONS IN THE UNITED STATES.

Paragraph 473 of the tariff act of July 24, 1897 (amended March 3, 1903), provides that—

> Any animal imported by a citizen of the United States specially for breeding purposes shall be admitted free, whether intended to be so used by the importer himself or for sale for such purpose: *Provided,* That no such animal shall be admitted free unless purebred of a recognized breed and duly registered in the books of record established for that breed: *And provided further,* That certificate of such record and of the pedigree of such animal shall be produced and submitted to the customs officer, duly authenticated by the proper custodian of such book of record, together with the affidavit of the owner, agent, or importer that such animal is the identical animal described in said certificate of record and pedigree: *And provided further,* That the Secretary of Agriculture shall determine and certify to the Secretary of the Treasury what are recognized breeds and purebred animals under the provisions of this paragraph.

Accordingly the Department of Agriculture has certified a large number of books of record of pedigrees and their publishing agencies. The list has been published in Circular No. 51, Division of Customs, Treasury Department, and in instructions to officers of the customs. The American books included in this circular and the ones certified since its publication (April 24, 1903) are given below, together with the names of the associations publishing them and the names and addresses of the publishing officer:

Certified books of record of pedigrees. American books.

Breed.	Book of record.	By whom published.	Secretary.	
			Name.	Address.
HORSES.				
American Trotter	American Trotting Register	American Trotting Registry Association	Wm. H. Knight	355 Dearborn street, Chicago, Ill.
Belgian Draft	American Register of Belgian Draft Horses.	American Association of Importers and Breeders of Belgian Draft Horses.	J. D. Conner, jr	Wabash, Ind.
Cleveland Bay	American Cleveland Bay Studbook	Cleveland Bay Society of America	R. P. Stericker	80 Chestnut avenue, West Orange, N. J.
Clydesdale	American Clydesdale Studbook	American Clydesdale Association	R. B. Ogilvie	Union Stock Yards, Chicago, Ill.
French Coach	French Coach Studbook	French Coach Horse Society of America	S. D. Thompson	503 Tacoma Building, Chicago, Ill.
French Draft	National Register of French Draft Horses.	National French Draft Horse Association	C. E. Stubbs	Fairfield, Iowa.
German Coach	German, Hanoverian, and Oldenburg Coach Horse Studbook.	German, Hanoverian, and Oldenburg Coach Horse Association of America.	J. Crouch	Lafayette, Ind.
Hackney	American Hackney Studbook	American Hackney Horse Society	A. H. Godfrey	Townsend Building, New York, N. Y.
Morgan	American Morgan Register	American Morgan Register Association	H. C. Shaw [a]	Middlebury, Vt.
Oldenburg	Oldenburg Coach Horse Register	Oldenburg Coach Horse Association of America	C. E. Stubbs	Fairfield, Iowa.
Percheron	American Percheron Studbook	American Percheron Horse Breeders and Importers' Association.	Geo. W. Stubblefield	Union Stock Yards, Chicago, Ill.
Do	Percheron	The Percheron Registry Company	Chas. C. Glenn	Columbus, Ohio.
Saddle Horse	American Saddle Horse Register	American Saddle Horse Breeders' Association	I. B. Nall	Louisville, Ky.
American Shetland pony	American Shetland Pony Club Studbook.	American Shetland Pony Club	Mortimer Levering	Lafayette, Ind.
Shire	American Shire Horse Studbook	American Shire Horse Breeders' Association	Charles Burgess	Wenona, Ill.
Suffolk	American Suffolk Horse Studbook	American Suffolk Punch Horse Association	Alex. Galbraith	Janesville, Wis.
Thoroughbred	American Studbook	The Jockey Club	James E. Wheeler [b]	571 Fifth avenue, New York, N. Y.

[a] Recording secretary. [b] Registrar.

Certified books of record of pedigrees. American books—Continued.

Breed.	Book of record.	By whom published.	Secretary.	
			Name.	Address.
ASSES.				
Jacks and jennets	American Jack Stock Studbook	American Breeders' Association of Jacks and Jennets.	J. W. Jones	Columbia, Tenn.
CATTLE.				
Aberdeen-Angus	American Aberdeen-Angus Herdbook.	American Aberdeen-Angus Breeders' Association.	Thomas McFarlane	Union Stock Yards, Chicago, Ill.
Ayrshire	Ayrshire Record	Ayrshire Breeders' Association	C. M. Winslow	Brandon, Vt.
Brown Swiss (Schwytz)	Swiss Record	Brown Swiss Cattle Breeders' Association	N. S. Fish	Groton, Conn.
Devon	American Devon Record	American Devon Cattle Club	L. P. Sisson	Newark, Ohio.
Dutch-Belted	Dutch-Belted Cattle Herdbook	Dutch-Belted Cattle Association	H. B. Richards	Easton, Pa.
Galloway	American Galloway Herdbook	American Galloway Breeders' Association	C. W. Gray	Union Stock Yards, Chicago, Ill.
Guernsey	Herd Register of the American Guernsey Cattle Club.	American Guernsey Cattle Club	Wm. H. Caldwell	Peterboro, N. H.
Hereford	American Hereford Record	American Hereford Cattle Breeders' Association	C. R. Thomas	225 West Twelfth street, Kansas City, Mo.
Holstein-Friesian	Holstein-Friesian Herdbook	Holstein-Friesian Association of America	Frederick L. Houghton.	Brattleboro, Vt.
Jersey	Herd Register of the American Jersey Cattle Club.	American Jersey Cattle Club	J. J. Hemingway	8 West Seventeenth street, New York, N. Y.
Polled Durham	American Polled Durham Herdbook.	American Polled Durham Breeders' Association	Fletcher S. Hines	Malottpark, Ind.
Red Polled	Red Polled Herdbook	Red Polled Cattle Club of America (Incorporated).	J. McLain Smith	Dayton, Ohio.
Shorthorn	American Shorthorn Herdbook	American Shorthorn Breeders' Association	John W. Groves	Union Stock Yards, Chicago, Ill.
Sussex	American Sussex Register	American Sussex Association	Overton Lea	Nashville, Tenn.
SHEEP.				
Cheviot	American Cheviot Sheep Flock Book.	American Cheviot Sheep Society	F. E. Dawley	Fayetteville, N. Y.
Cotswold	American Cotswold Record	American Cotswold Registry Association	F. W. Harding	Waukesha, Wis.

Dorset	Continental Dorset Club Sheep Record.	The Continental Dorset Club	J. E. Wing	Mechanicsburg, Ohio.
Dorset Horn	Flock Record of the Dorset Horn Sheep Breeders' Association of America.	Dorset Horn Sheep Breeders' Association of America.	M. A. Cooper	Washington, Pa.
Hampshire Down	Hampshire Down Flock Record	Hampshire Down Breeders' Association of America.	Comfort A. Tyler	Nottawa, Mich.
Leicester	American Leicester Record	American Leicester Breeders' Association	A. J. Temple	Cameron, Ill.
Lincoln	National Lincoln Sheep Breeders' Record.	National Lincoln Sheep Breeders' Association	Bert. Smith	Charlotte, Mich.
Merino (Delaine)	Black Top Spanish Merino Sheep Register.	Black Top Spanish Merino Sheep Breeders' Publishing Association.	R. P. Berry	Clokey, Pa.
Do	Dickinson Spanish Merino Sheep Register.	Dickinson Merino Sheep Record Company	H. G. McDowell	Canton, Ohio.
Do	Improved Delaine Merino Register	Improved Delaine Merino Sheep Breeders' Association.	Geo. A. Henry	Bellefontaine, Ohio.
Do	National Delaine Merino Register	National Delaine Merino Sheep Breeders' Association.	J. B. Johnson	Canonsburg, Pa.
Do	Standard Delaine Spanish Merino Sheep Breeders' Register.	Standard Delaine Spanish Merino Sheep Breeders' Association.	S. M. Cleaver	West Brownsville, Pa.
Merino (French)	American Rambouillet Record	American Rambouillet Sheep Breeders' Association.	Dwight Lincoln	Milford Center, Ohio.
Merino (German)	International von Homeyer Rambouillet Club Record.	International von Homeyer Rambouillet Club	E. M. Moore	Orchard Lake, Mich.
Merino (Spanish)	Register of the Michigan Merino Sheep Breeders' Association.	Michigan Merino Sheep Breeders' Association	E. N. Ball	Hamburg, Mich.
Do	Register of the National Merino Sneep Breeders' Association.	National Merino Sheep Breeders' Association	R. O. Logan	R. F. D. 3, Montgomery, Mich.
Do	Register of the New York State American Merino Sheep Breeders' Association.	New York State American Merino Sheep Breeders' Association.	J. H. Earll	Skaneateles, N. Y.
Do	Register of the Ohio Spanish Merino Sheep Breeders' Association.	Ohio Spanish Merino Sheep Breeders' Association.	Wesley Bishop	R. F. D. 1, Delaware, Ohio.

Certified books of record of pedigree. American books—Continued.

Breed.	Book of record.	By whom published.	Secretary.	
			Name.	Address.
SHEEP—continued.				
Merino (Spanish)	Register of the Standard American Merino Register Association.	Standard American Merino Register Association	J. P. Ray	Hemlock, N. Y.
Do	Register of the Vermont Merino Sheep Breeders' Association.	Vermont Merino Sheep Breeders' Association	C. A. Chapman [a]	Middlebury, Vt.
Oxford Down	American Oxford Record	American Oxford Down Record Association	W. A. Shafor	Hamilton, Ohio.
Shropshire	American Shropshire Sheep Record	American Shropshire Registry Association	Mortimer Levering	Lafayette, Ind.
Southdown	American Southdown Record	American Southdown Breeders' Association	Frank S. Springer	510 East Monroe street, Springfield, Ill.
Suffolk	Register of the American Suffolk Flock Registry Association.	American Suffolk Flock Registry Association	Geo. A. Franklin	Des Moines, Iowa.
HOGS.				
Berkshire	American Berkshire Record	American Berkshire Association	Frank S. Springer	510 East Monroe street, Springfield, Ill.
Cheshire	Cheshire Herdbook	Cheshire Swine Breeders' Association	Ed. S. Hill	Freeville, N. Y.
Chester White	American Chester White Record	American Chester White Record Association	Ernest Freigau	Dayton, Ohio.
Do	Chester White Record	Chester White Record Association	W. H. Morris	939–941 So. Illinois street, Indianapolis, Ind.
Chester, Ohio Improved	Ohio Improved Chester Record	Ohio Improved Chester Swine Breeders' Association.	C. M. Hiles	Ajax Building, Cleveland, Ohio.
Duroc-Jersey	American Duroc-Jersey Record	American Duroc-Jersey Swine Breeders' Association.	T. B. Pearson	Thorntown, Ind.
Do	National Duroc-Jersey Record	National Duroc-Jersey Record Association	Robt. J. Evans	El Paso, Ill.
Essex	American Essex Record	American Essex Association	F. M. Srout	McLean, Ill.
Hampshire (Thin Rind)	American Hampshire Record	American Hampshire Swine Record Association	E. C. Stone	Armstrong, Ill.
Poland-China	American Poland-China Record	American Poland-China Record Company	W. M. McFadden	Union Stock Yards, Chicago, Ill.
Do	Central Poland-China Record	Central Poland-China Record Association	W. H. Morris	939–941 So. Illinois street, Indianapolis, Ind.

Do	Ohio Poland-China Record	Ohio Poland-China Record Company	A. M. Brown	Dayton, Ohio.
Do	Southwestern Poland-China Record	Southwestern Poland-China Record Association	H. P. Wilson	Gadsden, Tenn.
Do	Standard Poland-China Record	Standard Poland-China Record Association	Geo. F. Woodworth	Maryville, Mo.
Tamworth	American Tamworth Swine Record	American Tamworth Swine Record Association	E. N. Ball	Hamburg, Mich.
Victoria	Record of the Victoria Swine Breeders' Association.	Victoria Swine Breeders' Association	H. Davis	Dyer, Ind.
Yorkshire	American Yorkshire Record	American Yorkshire Club	Harry G. Krun [a]	Whitebear Lake, Minn.
DOGS.				
Fifty-seven recognized breeds.	American Kennel Club Studbook	American Kennel Club	A. P. Vredenburg	55 Liberty street, New York, N. Y.
CATS.				
Long-haired (Angora or Persian), short-haired (Siamese, Manx, Mexican, Abyssinian, Indian, Russian, and Japanese.	The United States Register and Studbook (except appendix).	The United States Official Register Association (Incorporated).	Mrs. S. Hazen Bond	310 First street SE., Washington, D. C.

[a] Secretary and treasurer.

STATE LIVE STOCK BREEDERS' ASSOCIATIONS.[a]

Name of organization.	Secretary.	
	Name.	Address.
Alabama Stock Breeders' Association	E. A. Bishop	Talladega, Ala.
Arizona Cattle Growers' Association	Harry Heffner	Pantano, Ariz.
California Live Stock Breeders' Association	N. A. Chisholm	Jacinto, Cal.
Connecticut Sheep Breeders' Association	Burton C. Patterson	Torrington, Conn.
Colorado Cattle and Horse Growers' Association	Fred. P. Johnson	Denver, Colo.
Southeastern Stock Growers' Association	J. A. Hollomon	Jacksonville, Fla.
Southwest Georgia Live Stock Association	H. M. Mc Intosh[b]	Albany, Ga.
State Live Stock Breeders' Association	Geo. Ketchum	Macon, Ga.
Hawaiian Live Stock Breeders' Association	Albert F. Judd	Honolulu, Hawaii.
Idaho Wool Growers' Association	M. Gwinn	Boise, Idaho.
Inland Registered Stock Breeders' Association	H. T. French	Moscow, Idaho.
Wood River Cattle Growers' Association of Idaho	Merton Osborn	Hailey, Idaho.
Illinois Cattle Breeders' Association	O. H. Swigart	Champaign, Ill.
Illinois Cattle Feeders' Association	Chas. F. Mills	Springfield, Ill.
Illinois Horse Breeders' Association	George Williams	Athens, Ill.
Illinois Live Stock Breeders' Association	Fred H. Rankin	Urbana, Ill.
Illinois Sheep Breeders' Association	Eugene Funk	Bloomington, Ill.
Illinois Swine Breeders' Association	Chas. F. Mills	Springfield, Ill.
Indiana Improved Live Stock Breeders' Association.	J. H. Skinner	Lafayette, Ind.
Indiana Swine Breeders' Association	W. R. Midkiff	Shelbyville, Ind.
Indiana Wool Growers' Association	H. H. Keim	Ladoga, Ind.
Iowa Improved Live Stock Breeders' Association	W. J. Kennedy	Ames, Iowa.
Iowa Corn and Hog Breeders' Association	Geo. S. Prine	Oskaloosa, Iowa.
Improved Swine Breeders' Association	H. W. Cheney	Topeka, Kans.
Kansas Improved Stock Breeders' Association	H. A. Heath	Do.
Kentucky Live Stock Breeders' Association	Clarence Sale	Room 17, Board of Trade Building, Louisville, Ky.
Louisiana Stock Breeders' Association	W. H. Dalrymple	Baton Rouge, La.
Eastern Horse Breeders' Association	J. E. Osborne	Calais, Me.
Massachusetts Farmers and Cattle Owners' Association.	J. L. Harrington	Lunenburg, Mass.
Minnesota Live Stock Breeders' Association	Thos. Shaw	St. Paul, Minn.
Minnesota Sheep Breeders' Association	C. W. Glotfelter	Waterville, Minn.
Minnesota Swine Breeders' Association	Charles Kenning	Osceola, Minn.
Southern Live Stock Association	J. M. Aldrich[c]	Michigan City, Miss.
Improved Live Stock Breeders' Association	Geo. B. Ellis	Columbia, Mo.
Missouri State Sheep Breeders' Association	L. E. Shattuck	Springfield, Mo.
Central Montana Wool Growers' Association	A. C. Logan	Billings, Mont.
Montana Registered Cattle Breeders' Association	John W. Pace	Helena, Mont.
North Montana Round-Up Association	Roy M. Clary	Conrad, Mont.
Northern Montana Wool Growers' Association	Wm. Ewing	Great Falls, Mont.
Montana Stock Growers' Association	W. G. Preuitt	425 Power Block, Helena, Mont.
Nebraska Improved Live Stock Breeders' Association.	O. E. Mickey	Osceola, Nebr.
Nebraska Stock Growers' Association	A. L. Searle	Ogallala, Nebr.
State Swine Breeders' Association	A. T. Cole	Beatrice, Nebr.
New Mexico Cattle Growers' Association	W. C. Barnes	Dorsey, N. Mex.
New York State Sheep Breeders' Association	E. M. Berrham[c]	Hopewell Center, N. Y.
North Dakota Live Stock Association	E. S. Delancey	Valley City, N. Dak.

[a] This list excludes associations devoted to particular breeds, dairy cattle, dairying, and poultry.
[b] President.
[c] Secretary-treasurer.

State live stock breeders' associations—Continued.

Name of organization.	Secretary.	
	Name.	Address.
Ohio Horse Breeders' Association	Samuel Taylor	Grove City, Ohio.
Ohio Live Stock Association	C. S. Plumb	Columbus, Ohio.
Ohio Swine Breeders' Association	Carl Freigau [a]	Dayton, Ohio.
Ohio Wool Growers' and Sheep Breeders' Association.	W. N. Cowden	Quaker City, Ohio.
Improved Stock Breeders' Association of Oklahoma.	Emil Bracht	Oklahoma City, Okla.
Oklahoma Live Stock Association	W. E. Bolton	Woodward, Okla.
Oregon Live Stock Breeders' Association	M. D. Wisdom	Portland, Oreg.
Pennsylvania Live Stock Breeders' Association	E. S. Bayard	East End, Pittsburg, Pa.
South Carolina Live Stock Association	G. E. Nesom	Clemson College, S. C.
Missouri River Stockmen's Association	John Hayes	Fort Pierre, S. Dak.
Northwest Stock Growers' Association	Geo. W. Ross	Bellefourche, S. Dak.
South Dakota Improved Live Stock and Poultry Breeders' Association.	Jas. W. Wilson	Brookings, S. Dak.
Western South Dakota Live Stock Association	Frank M. Stewart	Buffalogap, S. Dak.
Tennessee Live Stock Breeders' Association	May Overton [b]	44 Arcade, Nashville, Tenn.
Cattle Raisers' Association of Texas	Jno. T. Lytle	Fort Worth, Tex.
Cattle Growers' Association of Utah	Wesley K. Walton	Murray, Utah.
Mount Pleasant Wool Growers' Association	Fred. Jensen	Mount Pleasant, Utah.
Utah Wool Growers' Association	O. P. Hatch	Salt Lake City, Utah.
Washington State Live Stock Association	Grant C. Copeland	Walla Walla, Wash.
West Virginia Live Stock Association	H. E. Williams	Duo, W. Va.
West Virginia Sheep Breeders and Wool Growers' Association.	J. M. Bell	Wellsburg, W. Va.
Wisconsin Live Stock Breeders' Association	Frank W. Harding	Waukesha, Wis.
Wisconsin Sheep Breeders' Association	.....do	Do.
Snake River Live Stock Association	Harry L. Hays	Dixon, Wyo.
Wyoming Stock Growers' Association	Alice R. Smith	Cheyenne, Wyo.

[a] Deceased. [b] President.

THE MOVEMENT OF LIVE-STOCK.

The tables which follow show the receipts and shipments of the different classes of live stock at the stock centers throughout the country for the year 1903, in total and by months. The returns are substantially complete for all the cities named, with the one or two exceptions noted, in which cases our agents found it impossible to get more complete figures. The totals of the columns must not be taken as representing so many separate animals, because there are of necessity a great number of duplications; receipts at one city will appear later in the arrivals at another place, and, in cases of long journeys, possibly a third or fourth registration will occur. However, the figures as given serve to show the extent of the movement of stock at each of the centers, and also, in a general way, the local consumption, including the packing, which may be seen by noting the difference between the receipts and shipments.

In addition there will also be found tables giving the average weights of hogs at leading centers for a series of years, and also statements of the range and average prices of the different classes of cattle, hogs, sheep, and horses at Chicago and Omaha.

Receipts and shipments of live stock, 1901 to 1903.

Animals.	1901.		1902.		1903.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
	Number.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
Cattle	10,807,494	4,205,708	11,396,925	4,788,991	12,170,273	5,109,409
Calves	1,104,890	246,321	1,289,835	250,751	1,552,535	352,210
Hogs	34,464,424	7,524,444	30,520,945	7,270,307	31,132,634	7,773,795
Sheep	15,803,068	5,821,635	17,573,466	6,884,230	19,199,680	8,333,438
Horses and mules	695,997	523,592	616,840	485,949	615,749	494,044
Total	62,875,873	18,321,700	61,398,011	19,680,228	64,670,871	22,062,896

Summary of receipts and shipments of live stock at leading cities during the calendar year of 1903.

Stock center.	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
	Number.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
Chicago	3,432,486	1,269,455	271,743	26,244	7,325,923	1,237,554	4,582,760	1,000,109	100,603	94,768
Kansas City	1,953,371	919,987	183,741	82,676	1,969,381	77,673	1,151,730	354,417	67,274	63,439
Omaha	1,071,177	301,351			2,231,067	50,809	1,863,763	892,199	52,829	51,805
South St. Paul	260,194	187,979	42,631	23,654	759,735	49,704	875,411	682,078	7,794	6,700
Sioux City	372,506	302,175	6,940	2,825	1,007,900	538,437	41,774	24,222	12,044	11,761
St. Louis	30,086	4,736	5,976		233,798	7,646	19,989	2,955		
National Stock Yards	1,139,749	318,316			1,568,038	248,647	528,089	76,610	128,615	107,883
Indianapolis	249,931	91,574			1,530,888	479,611	101,084	68,645	34,886	28,927
St. Joseph	579,933	175,701	45,041	15,520	1,700,564	123,049	599,189	156,652	20,483	20,010
Milwaukee	51,517	12,003	46,142	2,833	529,400	10,672	52,117	7,030	3,264	1,513
Pittsburg	151,710		59,522		854,468		510,872			
Lincoln	111,901				8,121		[a] 598,385		19,492	
Cincinnati	201,126	50,174	2,348		854,794	320,004	406,252	299,572	17,910	8,608
Cleveland	43,489		35,123		766,593	[a] 289,694	174,816			
Philadelphia	154,697	52,139	61,268	1,436	237,047	3,203	503,970	53,151	11,839	7,859
Baltimore	168,916	114,044	125,170	4,696	701,064	166,267	440,847	268,888	7,379	6,443
East Buffalo	533,280	445,984	89,012	66,759	4,660,000	3,609,120	2,074,400	1,863,400	55,420	48,146
Louisville	114,904	53,056	14,226	2,323	723,967	365,289	294,076	322,117	5,637	5,802
Detroit	70,494	24,704	21,496	3,900	374,278	75,423	148,634	49,236	500	445
Jersey City	302,427	275,592	84,402	41,680	570,216		1,850,430	1,213,468		
New York [a]	127,350		259,000		717,424		422,237		17,904	1,581
Denver	286,271	[a] 247,132			146,580	[a] 4,573	464,896	[a] 387,541	19,040	[a] 17,075
Pueblo	72,908				1,161		155,421		15,167	
Fort Worth	375,795	83,109	71,003	33,100	150,504	2,385	125,322	70,663	10,094	3,569
Portland, Oreg	24,994	17,675			44,069	30,888	139,991	98,612	2,371	2,059
San Francisco [a]	66,390		8,530		146,932		158,793			
New Brighton, Minn	60,148	59,867			500	500	399,003	307,724	3,811	3,837
Weehawken and Hoboken, N. J	75,341	75,341	44,564	44,564	82,647	82,647	108,086	108,086	1,393	1,393
Boston	87,182	[a] 27,315	74,657		1,235,575		407,343	[a] 26,063		419
Total	12,170,273	5,109,409	1,552,535	352,210	31,132,634	7,773,795	19,199,680	8,333,438	615,749	494,044

[a] See note under this city in succeeding tables.

Receipts and shipments of live stock at leading cities in 1903.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
CHICAGO.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	275,388	95,221	13,527	2,846	817,586	108,331	361,049	23,632	10,497	10,490
February	238,456	79,565	11,777	1,274	687,871	150,467	300,634	19,291	12,397	11,865
March	264,031	93,575	19,342	898	522,317	126,520	304,372	31,984	16,483	14,877
April	279,721	103,522	37,546	2,343	527,242	87,341	274,993	24,758	10,860	10,704
May	231,265	98,257	30,779	1,273	571,492	65,693	231,676	12,820	8,530	8,483
June	303,041	108,960	27,609	957	676,963	99,547	323,589	16,538	7,630	6,602
July	282,012	98,143	29,367	2,981	545,124	91,111	318,306	45,056	4,375	4,471
August	293,001	99,216	22,642	2,329	737,924	108,494	427,209	134,679	6,526	5,384
September	341,371	108,922	23,204	3,213	465,403	98,485	555,161	196,755	7,527	6,671
October	338,763	146,285	25,243	4,607	451,331	90,798	585,561	238,663	6,116	6,067
November	302,038	113,578	17,627	1,809	637,281	103,592	519,178	174,357	5,867	4,983
December	283,399	114,211	13,080	1,714	885,389	107,175	381,031	81,576	3,795	4,171
Total	3,432,486	1,269,455	271,743	26,244	7,325,923	1,237,554	4,582,760	1,000,109	100,603	94,768
KANSAS CITY.										
January	152,139	60,276	7,630	1,816	160,864	....	68,957	8,567	8,382	7,980
February	129,660	52,959	3,633	....	156,603	548	76,758	9,587	8,562	8,558
March	125,293	55,311	3,857	....	137,111	197	90,793	19,457	7,465	7,435
April	128,678	49,903	4,508	1,565	186,707	468	125,764	22,927	6,160	6,132
May	105,365	37,577	2,967	399	241,774	6,113	128,777	27,088	4,464	4,381
June	34,216	16,156	2,445	1,287	116,817	23,056	15,981	2,826	1,742	1,712
July	132,105	50,885	21,766	12,740	201,532	24,392	58,935	17,315	3,787	3,785
August	201,832	98,675	30,657	16,596	137,566	16,494	82,612	31,929	5,392	5,388
September	290,959	168,317	30,875	16,651	149,757	4,077	150,255	67,335	6,023	6,011
October	280,545	158,282	41,202	21,312	138,406	....	157,675	70,349	5,422	4,456
November	213,226	103,807	23,524	7,607	162,210	....	122,044	58,787	4,512	3,608
December	159,353	67,839	10,677	2,703	180,034	2,328	73,179	18,250	5,363	3,993
Total	1,953,371	919,987	183,741	82,676	1,969,381	77,673	1,151,730	354,417	67,274	63,439

OMAHA.										
January	76,988	13,162			197,433	970	98,379	10,203	1,540	1,392
February	75,591	16,458			204,040	1,295	112,352	20,869	1,589	1,505
March	83,698	20,995			163,618	943	141,441	33,007	2,029	2,000
April	87,136	19,131			182,564	1,073	104,716	26,048	1,569	1,457
May	75,146	14,322			239,702	2,614	58,506	13,182	1,039	1,045
June	102,064	23,549			276,947	7,761	41,378	5,224	3,314	3,259
July	64,372	11,503			209,566	483	114,695	43,934	10,046	9,780
August	76,120	17,625			158,799	7,983	161,418	86,055	10,475	8,656
September	122,377	50,137			130,166	9,109	267,755	170,084	8,972	10,650
October	137,366	62,015			100,479	4,168	352,191	260,218	8,175	8,095
November	100,750	34,780			150,085	9,531	260,283	165,808	3,083	2,957
December	69,569	17,674			217,668	4,879	150,649	57,567	998	1,009
Total	1,071,177	301,351			2,231,067	50,809	1,863,763	892,199	52,829	51,805
SOUTH ST. PAUL.										
January	12,299	5,129	1,696	406	95,398	5,813	65,928	40,826	67	102
February	10,001	4,625	1,696	1,193	61,783	1,097	56,593	29,800	95	80
March	18,097	10,615	5,343	2,770	58,240	1,321	33,865	26,452	59	100
April	21,118	14,981	9,308	6,333	58,835	4,201	13,068	32,744	172	147
May	11,215	7,751	4,569	4,942	61,834	2,564	3,692	11,113	91	72
June	12,061	6,709	4,567	2,629	67,772	5,067	11,677	13,677	342	280
July	9,808	6,261	2,833	1,190	42,491	932	21,333	11,936	2,603	1,563
August	20,625	14,246	1,720	806	23,235	522	50,886	41,131	1,705	1,563
September	50,507	42,903	3,399	1,248	30,343	833	91,305	68,309	1,166	1,259
October	51,632	44,741	3,432	835	56,890	2,466	258,072	204,357	1,167	1,225
November	32,636	24,466	2,554	900	91,539	8,206	205,289	139,232	163	157
December	10,195	5,552	1,514	402	111,375	16,682	63,703	62,501	164	152
Total	260,194	187,979	42,631	23,654	759,735	49,704	875,411	682,078	7,794	6,700
SIOUX CITY.										
January	21,881	14,562	138	21	103,714	52,011	3,703	1,747	147	129
February	27,057	21,405	196	30	88,497	44,499	5,146	1,112	391	329
March	34,195	25,286	391	44	60,830	30,582	1,610	552	177	228
April	32,118	27,123	370	66	73,669	37,060	2,280	669	196	161
May	52,627	49,676	465	263	101,904	53,095	1,799	571	598	185

Receipts and shipments of live stock at leading cities in 1903—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
SIOUX CITY—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
June	49,008	40,852	314	67	112,451	60,274	1,784	780	2,820	3,221
July	25,538	22,429	815	446	82,696	43,409	2,344	967	2,435	2,423
August	15,434	9,859	1,035	608	58,316	33,003	1,789	808	3,428	3,329
September	32,925	24,282	920	491	42,355	22,956	5,436	4,035	979	904
October	42,217	85,496	939	116	43,707	21,964	7,667	6,055	369	344
November	23,985	18,607	1,060	591	103,669	58,849	6,999	5,907	194	198
December	15,521	12,598	350	82	135,792	80,735	1,217	1,024	310	310
Total	372,506	302,175	6,940	2,825	1,007,900	538,437	41,774	24,222	12,044	11,761
ST. LOUIS.										
January	1,543	392	238	....	19,004	104	1,205	243	....	....
February	1,347	295	329	....	15,702	533	1,126	63	....	....
March	1,728	354	481	....	18,914	873	363	68	....	....
April	2,617	506	513	....	18,796	723	1,479	264	....	....
May	2,753	374	580	....	22,033	786	681	62	....	....
June	2,574	283	595	....	21,373	896	2,142	680	....	....
July	2,526	278	663	....	19,617	494	2,236	183	....	....
August	2,621	481	537	....	18,138	461	2,180	507	....	....
September	3,439	479	655	....	20,410	1,412	2,240	....	....	....
October	3,547	319	561	....	20,732	1,167	2,025	165	....	....
November	2,778	522	544	....	18,703	121	2,263	225	....	....
December	2,613	453	280	....	20,376	76	2,049	495	....	....
Total	30,086	4,736	5,976	....	233,798	7,646	19,989	2,955	....	....
NATIONAL STOCK YARDS.										
January	80,789	18,732	....	....	140,190	11,847	30,858	1,911	15,402	13,618
February	61,296	15,351	....	....	126,416	18,444	33,374	642	13,672	12,356
March	58,139	12,462	....	....	115,272	24,117	26,415	961	13,918	11,381
April	54,822	14,461	....	....	118,614	20,840	44,598	7,347	10,646	8,618

May	76,895	15,858	....	....	141,019	19,788	62,329	13,223	7,375	5,621
June	70,215	24,065	....	....	100,226	28,039	53,194	14,136	3,497	2,884
July	127,119	45,276	....	....	149,867	32,973	54,284	11,127	6,954	5,414
August	131,099	35,281	....	....	125,655	30,213	50,303	12,399	11,391	7,673
September	153,329	47,903	....	....	130,264	28,721	48,961	4,152	11,781	10,637
October	140,349	41,715	....	....	147,203	20,962	47,045	4,511	12,333	11,137
November	103,265	28,539	....	....	119,432	5,835	35,408	1,944	9,983	7,852
December	82,432	18,673	....	....	153,880	6,868	41,320	4,257	11,663	10,689
Total	1,139,749	318,316	....	....	1,568,038	248,647	528,089	76,610	128,615	107,883
INDIANAPOLIS.										
January	17,121	6,005	....	....	139,453	53,271	9,038	7,012	4,344	3,789
February	15,880	5,073	....	....	79,483	30,328	4,569	2,882	3,519	3,057
March	15,374	4,991	....	....	68,363	20,477	2,633	1,274	4,732	3,999
April	16,896	4,479	....	....	72,836	27,352	4,113	2,221	3,407	3,015
May	16,529	4,631	....	....	124,530	16,864	7,031	4,537	2,776	2,385
June	24,533	8,091	....	....	150,843	38,669	14,611	10,477	2,052	1,443
July	26,354	12,090	....	....	173,137	52,210	11,450	7,420	1,504	1,387
August	22,776	8,840	....	....	131,493	53,061	13,999	9,797	2,992	2,172
September	27,271	10,765	....	....	106,107	49,027	15,506	8,602	3,030	2,362
October	26,662	11,013	....	....	132,492	43,269	6,813	4,815	3,008	2,373
November	20,764	8,735	....	....	152,058	40,880	7,325	4,893	1,684	1,380
December	19,771	6,861	....	....	200,093	53,903	6,996	4,715	1,838	1,575
Total	249,931	91,574	....	....	1,530,888	479,611	101,084	68,645	34,886	28,927
ST. JOSEPH.										
January	40,906	8,697	1,767	373	138,797	568	39,778	4,799	1,752	1,575
February	36,550	10,982	1,576	520	140,677	169	44,359	6,667	1,733	1,657
March	35,623	9,561	2,212	1,006	124,964	238	63,578	12,320	1,772	1,954
April	38,695	9,809	2,337	1,788	126,363	1,359	75,868	12,255	1,088	1,106
May	43,630	17,931	1,176	591	155,066	416	60,199	7,939	1,437	1,425
June	73,994	21,953	6,007	913	201,865	27,110	60,844	14,292	1,334	1,259
July	38,805	10,748	5,579	2,163	175,336	23,726	25,708	10,742	1,885	1,687
August	16,304	3,951	1,610	190	41,870	8,676	18,994	7,125	1,082	992
September	63,430	20,856	5,647	2,099	124,831	25,849	69,339	36,369	1,802	1,832
October	70,241	26,875	7,981	3,367	93,305	6,431	53,642	22,156	1,897	1,779

Receipts and shipments of live stock at leading cities in 1903—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
ST. JOSEPH—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
November	51,373	16,066	4,079	1,233	116,873	3,224	17,003	2,669	1,626	1,494
December	39,340	9,706	2,048	1,170	156,839	8,708	33,924	5,659	997	1,129
Total	579,933	175,701	45,041	15,520	1,700,564	123,049	599,189	156,652	20,483	20,010
MILWAUKEE.										
January	4,119	1,051	2,916	144	61,447	1,546	4,503	868	122	70
February	3,902	463	2,673	6	25,323	1,064	2,856		240	
March	3,823	1,079	4,208	273	29,339	1,222	2,029	322	380	204
April	3,806	1,082	5,764	764	31,281	2,137	819	26	199	45
May	3,103	521	5,307	125	29,820	1,445	1,823	83	321	82
June	3,907	669	5,962	195	39,256		4,705	603	310	104
July	3,850	682	5,325	530	30,961	58	4,823	346	138	25
August	4,097	662	3,088	12	30,710	53	5,977	490	312	193
September	4,931	901	2,589	9	30,622	367	6,432	943	224	146
October	5,743	1,425	2,697	64	32,665	1,960	7,208	1,392	329	169
November	5,379	2,035	2,377	356	101,209	523	6,268	1,330	498	368
December	4,857	1,433	3,236	355	86,767	297	4,674	627	191	107
Total	51,517	12,003	46,142	2,833	529,400	10,672	52,117	7,030	3,264	1,513
PITTSBURG.										
January	10,480		2,045		93,597		48,724			
February	10,728		1,786		60,798		38,292			
March	11,087		4,748		45,762		32,378			
April	10,921		11,272		36,731		46,864			
May	9,699		9,925		53,325		60,707			
June	12,755		8,755		67,980		69,016			
July	12,426		5,552		61,439		37,020			
August	17,512		3,488		61,713		38,178			
September	16,764		3,405		56,555		36,157			

October	13,016		3,279		86,279		36,567			
November	16,111		3,002		113,925		34,841			
December	9,211		2,265		116,514		32,125			
Total	151,710		59,522		854,468		510,872			
LINCOLN.[a]										
January	3,770				546		23,766		405	
February	2,199				1,229		33,442		719	
March	1,655				950		56,540		1,044	
April	1,377				522		36,399		424	
May	1,622				814		17,142		271	
June	12,554				851		3,385		1,344	
July	1,512				320		17,397		2,954	
August	7,698				625		52,057		4,250	
September	17,260				443		109,130		2,898	
October	27,893				688		130,528		2,051	
November	25,268				581		103,129		2,514	
December	9,093				552		14,470		618	
Total	111,901				8,121		598,385		19,492	
CINCINNATI.										
January	14,395	2,701	136		79,956	28,336	11,244	3,963	841	555
February	13,073	2,276	131		54,832	20,276	7,990	1,572	702	459
March	15,470	2,291	210		45,496	16,511	6,318	1,647	1,805	624
April	15,168	2,765	234		54,998	19,181	10,397	3,133	2,119	961
May	18,003	4,227	195		66,261	23,894	20,323	12,183	1,800	977
June	18,340	3,830	273		72,075	26,511	99,044	83,405	1,479	440
July	15,545	4,269	197		63,406	24,375	130,022	111,878	842	182
August	16,186	4,505	202		65,802	25,680	62,872	56,317	1,319	723
September	21,551	7,546	197		64,791	26,771	26,272	14,698	2,198	1,213
October	21,506	7,135	240		86,533	38,305	15,582	6,112	2,107	1,212
November	17,738	5,320	128		84,246	33,127	9,671	2,999	1,516	970
December	14,151	3,309	205		116,398	37,037	6,517	1,665	1,182	592
Total	201,126	50,174	2,348		854,794	320,004	406,252	299,572	17,910	8,608

[a] The majority (511,154) of the sheep in this table were received at Burnham.

Receipts and shipments of live stock at leading cities in 1903—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
CLEVELAND.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January	4,290	...	1,649	...	99,141	a 33,930	9,104	...	...	...
February	4,016	...	1,675	...	57,763	a 16,397	20,124	...	...	...
March	3,711	...	3,388	...	42,759	a 9,625	10,854	...	...	...
April	4,853	...	5,267	...	41,938	a 10,680	12,719	...	...	...
May	3,623	...	3,974	...	72,419	a 22,968	12,923	...	...	...
June	4,151	...	3,513	...	77,677	37,648	13,277	...	...	...
July	3,914	...	2,894	...	67,288	33,012	12,137	...	...	...
August	3,254	...	2,694	...	56,336	15,380	14,247	...	...	...
September	2,688	...	2,534	...	57,364	17,159	15,823	...	...	...
October	2,875	...	2,795	...	79,116	31,951	17,314	...	...	...
November	3,426	...	2,306	...	101,309	43,785	20,471	...	...	...
December	2,688	...	2,534	...	13,483	17,159	15,823	...	...	...
Total	43,489	...	35,123	...	766,593	289,694	174,816	...	...	...
PHILADELPHIA.										
January	10,631	3,002	3,760	...	22,593	276	38,299	3,331	1,326	806
February	11,317	4,375	3,985	22	18,989	546	36,275	4,218	1,076	962
March	13,545	4,197	4,871	26	18,285	56	34,075	1,630	1,788	1,399
April	12,435	4,001	6,175	44	17,715	...	31,846	2,628	1,567	679
May	13,439	5,466	7,277	192	17,374	211	35,846	3,980	1,451	575
June	16,202	4,647	7,054	94	21,340	25	58,249	6,200	1,113	513
July	11,955	4,761	5,364	229	15,110	166	42,259	6,602	490	366
August	14,834	3,786	4,483	148	18,297	48	56,464	9,052	617	556
September	12,740	5,285	5,233	306	18,498	275	46,164	5,658	761	496
October	12,849	4,753	5,544	191	22,250	420	44,068	3,976	733	471
November	14,080	4,200	3,658	78	26,591	445	47,351	2,925	448	527
December	10,670	3,666	3,864	106	20,005	735	33,074	2,951	469	509
Total	154,697	52,139	61,268	1,436	237,047	3,203	503,970	53,151	11,839	7,859

BALTIMORE.										
January	11,680	8,438	1,490	192	65,612	14,866	26,124	12,674	1,133	925
February	11,598	7,626	1,942	185	58,854	17,075	17,906	7,178	1,131	1,022
March	10,304	6,356	7,083	139	55,369	16,311	19,240	7,431	1,315	1,165
April	12,601	7,964	9,114	149	51,771	16,281	21,981	7,847	432	315
May	9,481	5,868	7,190	164	52,590	12,115	34,444	14,232	366	297
June	11,322	6,957	8,683	549	52,990	11,542	52,614	39,175	178	136
July	13,569	8,847	10,173	684	48,434	9,247	66,170	47,019	141	68
August	15,494	10,864	12,213	539	54,842	10,575	54,503	39,506	382	380
September	20,830	13,859	15,369	713	58,230	13,556	46,231	25,378	318	278
October	21,509	16,340	17,752	•801	61,710	19,822	45,465	34,733	584	507
November	17,296	11,717	11,717	372	65,281	12,918	34,431	21,428	668	675
December	13,132	9,208	9,208	209	75,381	11,958	21,739	12,287	731	475
Total	168,916	114,044	125,170	4,696	701,064	166,267	440,847	268,888	7,379	6,443
EAST BUFFALO.										
January	57,442	51,304	4,824	3,618	468,320	370,240	247,400	234,400	5,280	4,541
February	44,968	38,698	4,759	3,569	337,280	261,120	220,200	187,600	6,580	5,396
March	52,910	46,090	7,158	5,369	314,240	230,880	189,600	173,800	9,800	8,816
April	48,532	42,460	11,131	8,348	282,080	209,120	171,400	142,600	6,620	6,802
May	51,810	44,506	9,628	7,221	325,760	251,840	130,800	115,400	6,520	5,073
June	43,648	36,168	8,547	6,410	381,760	320,320	120,000	83,000	3,600	3,458
July	31,834	25,080	6,341	4,756	346,880	278,880	110,400	93,000	2,220	1,957
August	38,874	30,602	8,130	6,097	368,160	286,080	129,600	111,600	3,240	2,603
September	39,094	32,648	7,282	5,462	369,920	277,440	140,600	133,800	3,920	3,078
October	42,548	33,330	9,025	6,769	429,920	329,920	180,600	170,400	3,680	2,622
November	44,374	33,924	7,042	5,281	501,120	380,640	220,200	210,200	2,480	2,432
December	47,246	31,174	5,145	3,859	534,560	412,640	213,600	207,600	1,480	1,368
Total	533,280	445,984	89,012	66,759	4,660,000	3,609,120	2,074,400	1,863,400	55,420	48,146
LOUISVILLE.										
January	11,571	5,000	1,067	218	77,806	37,440	1,248	484	1,164	1,232
February	8,179	3,615	935	187	49,640	21,415	1,845	724	578	472
March	8,999	3,959	1,320	166	54,658	25,901	2,867	1,807	568	395
April	8,311	3,853	1,367	128	56,454	28,992	10,069	6,979	443	355
May	8,299	4,506	1,263	111	61,663	31,963	33,443	29,802	356	317

a Not complete.

Receipts and shipments of live stock at leading cities in 1903—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
LOUISVILLE—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
June	9,543	4,320	1,383	289	60,177	28,143	108,564	99,477	300	289
July	6,992	3,260	1,252	399	48,638	21,219	81,561	78,126	393	327
August	9,158	3,929	1,000	178	40,046	19,414	32,016	27,689	305	670
September	13,051	6,562	1,269	301	44,122	19,667	12,017	8,912	338	413
October	12,215	5,908	1,319	97	71,530	46,387	5,931	3,304	446	602
November	10,436	4,279	995	128	79,716	48,662	2,927	1,225	222	221
December	8,130	3,865	1,046	121	79,517	36,086	1,588	578	524	495
Total	114,904	53,056	14,226	2,323	723,967	365,289	294,076	322,117	5,637	5,802
DETROIT.										
January	4,196	935	1,366	640	32,583	6,445	16,572	7,348		
February	3,186	560	987	143	22,953	3,744	16,821	7,885	60	60
March	5,242	2,205	2,028	387	32,965	5,549	13,895	5,213	45	23
April	5,399	2,388	2,236	194	28,822	9,214	8,418	2,455	35	35
May	4,724	1,489	2,074	264	27,277	7,621	6,967	985	41	41
June	7,577	2,581	2,585	188	31,286	6,519	9,812	883	27	27
July	6,080	2,755	1,982	288	21,326	3,630	9,578	2,636	55	25
August	7,973	3,000	1,880	222	31,422	3,648	12,595	3,304	81	81
September	6,290	2,614	1,470	218	26,579	5,267	11,909	3,683	50	50
October	6,358	2,146	1,615	280	25,509	5,378	13,696	4,305	106	103
November	8,962	2,931	1,928	706	51,586	10,105	16,180	5,221		
December	4,507	1,100	1,345	370	41,970	8,303	12,191	5,328		
Total	70,494	24,704	21,496	3,900	374,278	75,423	148,634	49,236	500	445
JERSEY CITY.										
January	24,903	22,657	5,419	3,979	62,416		148,805	91,495		
February	21,210	19,313	5,614	3,782	48,319		144,909	94,693		
March	21,662	19,512	10,540	6,912	45,210		136,606	89,746		
April	22,167	20,267	11,132	4,512	43,619		132,218	82,968		

May	22,200	20,090	9,310	2,478	38,410		140,004	103,992		
June	21,880	19,564	7,484	1,264	32,310		145,116	94,756		
July	24,822	22,810	7,023	2,803	29,560		152,508	79,444		
August	27,208	24,658	6,890	3,439	44,500		180,416	106,896		
September	28,593	26,163	5,610	3,151	56,219		197,023	123,623		
October	31,584	29,024	5,918	3,478	49,615		190,815	148,165		
November	26,788	24,358	4,416	2,656	51,420		185,600	142,290		
December	29,410	27,176	5,046	3,226	68,618		96,410	55,400		
Total	302,427	275,592	84,402	41,680	570,216		1,850,430	1,213,468		
NEW YORK.[a]										
January	17,416		10,829		52,264		61,434		1,387	154
February	11,116		10,409		42,866		45,218		1,711	154
March	10,054		19,240		51,333		32,833		2,574	318
April	10,598		33,211		37,664		31,420		2,025	210
May	12,708		41,558		58,208		31,450		1,618	160
June	11,422		43,156		54,072		8,841		1,458	102
July	9,286		29,114		48,312		12,596		697	75
August	8,932		18,862		64,168		10,642		1,180	59
September	8,962		14,065		57,555		29,115		1,424	36
October	11,489		17,428		91,422		65,315		1,413	75
November	8,249		11,363		77,233		50,479		1,666	113
December	7,088		9,765		82,327		42,894		751	125
Total	127,350		259,000		717,424		422,237		17,904	1,581
DENVER.[b]										
January	13,012	10,072			10,765	266	26,750	17,664	798	675
February	8,460	5,964			12,245	715	27,072	22,008	277	225
March	7,678	5,068			12,200	624	11,425	5,584	547	539
April	7,234	4,475			13,936	388	6,498	1,748	1,140	1,054
May	72,130	63,013			10,038	134	12,012	5,779	693	494
June	78,000	77,893			13,816	85	4,618	1,990	2,549	1,669
July	19,470	19,000			8,324	258	13,625	7,391	1,967	1,816
August	11,417	8,074			9,619	399	30,660	24,302	1,958	1,738

[a] Returns are not complete.
[b] The shipments from Denver are those by rail only; the stock yard report does not give the number driven out for feeding, etc.

Receipts and shipments of live stock at leading cities in 1903—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
DENVER—continued.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
September	11,708	6,597			11,242	325	33,715	20,931	3,272	2,990
October	19,815	16,216			14,708	708	151,715	144,278	2,891	3,045
November	22,618	19,539			15,122	523	107,093	99,932	1,819	1,597
December	14,729	11,221			14,565	148	39,713	35,934	1,129	1,233
Total	286,271	247,132			146,580	4,573	464,896	387,541	19,040	17,075
PORTLAND, OREG.										
January	2,882	2,280			5,104	4,392	7,992	4,484	252	232
February	1,861	1,008			2,786	2,140	11,597	9,797	213	200
March	2,595	2,260			3,312	2,541	11,186	10,275	296	243
April	1,928	1,686			3,331	2,784	5,733	3,873	194	171
May	1,424	1,184			3,521	3,093	8,347	3,607	173	220
June	3,074	2,033			2,875	2,560	24,299	17,401	401	268
July	3,362	2,361			2,227	1,800	10,015	6,533	149	102
August	1,655	886			2,202	1,094	10,024	3,825	130	144
September	1,763	1,427			5,235	3,697	6,723	3,034	284	258
October	1,602	1,014			5,065	2,709	18,217	17,345	119	126
November	1,129	693			4,749	2,503	10,331	6,932	90	53
December	1,719	843			3,662	1,575	15,507	11,506	70	42
Total	24,994	17,675			44,069	30,888	139,991	98,612	2,371	2,059
SAN FRANCISCO.[a]										
January	6,253		608		12,067		14,028			
February	5,392		431		8,664		12,779			
March	4,745		377		7,703		11,809			
April	5,519		551		8,839		15,036			
May	5,495		587		8,985		10,362			
June	5,372		661		7,210		12,769			
July	5,145		928		10,747		15,821			
August	5,219		899		14,332		12,986			

September	5,584	....	855	....	17,234	....	12,310	....	....	....
October	7,334	....	840	....	18,991	....	16,477	....	....	....
November	4,791	....	846	....	14,724	....	13,275	....	....	....
December	5,541	....	947	....	17,436	....	11,141	....	....	....
Total	66,390	....	8,530	....	146,932	....	158,793	....	....	....
PUEBLO.										
January	4,473	....	....	....	546	....	3,885	....	1,151	....
February	1,259	....	....	....	312	....	511	....	1,122	....
March	870	....	....	....	132	....	2,330	....	772	....
April	379	....	....	....	....	....	1,150	....	484	....
May	14,420	....	....	....		....	863	....	710	....
June	25,225	....	....	....	....	....	1,120	....	1,490	....
July	7,328	....	....	....		....	9,355	....	1,463	....
August	1,593	....	....	....	....	....	22,283	....	1,827	....
September	2,988	....	....	....	46	....	19,500	....	1,540	....
October	6,330	....	....	....	....	....	66,942	....	1,885	....
November	5,429	....	....	....	81	....	19,780	....	2,157	....
December	2,614	....	....	....	44	....	7,702	....	556	....
Total	72,908	....	....	....	1,161	....	155,421	....	15,167	....
FORT WORTH.										
January	17,369	4,255	1,788	1,294	9,818	7	489	302	18	11
February	12,439	824	599	72	9,022	7	755	....	1	1
March	16,824	2,417	1,046	222	15,140	168	2,598	302	42	42
April	27,398	9,873	2,538	254	19,827	493	29,642	21,434	198	198
May	38,969	14,853	1,661	348	10,037	5	40,135	23,824	141	141
June	41,572	11,685	5,982	210	16,235	176	24,637	9,949	77	78
July	28,391	4,512	6,935	1,279	7,215	5	6,536	2,829	377	377
August	27,725	3,186	9,360	2,182	4,483	322	4,758	2,393	293	240
September	37,175	4,783	8,242	6,346	10,376	537	2,493	1,140	2,737	801
October	36,423	6,800	13,374	10,863	17,483	134	3,031	458	3,529	953
November	53,345	13,186	12,974	6,475	16,323	524	1,911	591	1,150	496
December	38,165	6,735	6,504	3,555	14,545	7	8,337	7,441	1,531	231
Total	375,795	83,109	71,003	33,100	150,504	2,385	125,322	70,663	10,094	3,569

a Returns are incomplete.

Receipts and shipments of live stock at leading cities in 1903—Continued.

Stock yards at—	Cattle.		Calves.		Hogs.		Sheep.		Horses and mules.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
NEW BRIGHTON, MINN.	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
January							32,771	30,796		
February							9,135	6,808		122
March	422	496					288	13,310	120	118
April	241	281					4,401	20,186		
May	836	757			50	50	427	14,726	97	97
June	233	233			52	52	434	3,046	794	700
July	54	54			27	27	17,282	18,195	482	546
August	6,300	6,080					25,234	25,234	807	716
September	14,999	15,248			101	101	33,285	27,501	1,114	1,060
October	24,988	24,659			210	210	108,216	73,806	102	245
November	11,881	11,865			60	60	119,643	59,137	274	212
December	194	194					47,887	14,979	21	21
Total	60,148	59,867			500	500	399,003	307,724	3,811	3,837
WEEHAWKEN AND HOBOKEN, N. J.										
January	6,363	6,363	2,454	2,454	15,424	15,424	4,855	4,855	143	143
February	5,325	5,325	1,516	1,516	14,108	14,108	6,882	6,882	184	184
March	5,608	5,608	2,435	2,435	18,198	18,198	8,678	8,678	201	201
April	5,369	5,369	3,992	3,992	15,640	15,640	6,882	6,882	128	128
May	7,099	7,099	9,365	9,365	9,614	9,614	8,225	8,225	129	129
June	6,843	6,843	7,490	7,490	1,096	1,096	4,428	4,428	122	122
July	7,608	7,608	4,363	4,363	870	870	3,456	3,456	56	56
August	6,779	6,779	3,736	3,736	1,417	1,417	9,942	9,942	52	52
September	6,820	6,820	3,340	3,340	2,724	2,724	13,655	13,655	125	125
October	6,219	6,219	2,015	2,015	2,344	2,344	10,250	10,250	115	115
November	5,750	5,750	2,028	2,028	655	655	18,149	18,149	116	116
December	5,558	5,558	1,830	1,830	557	557	12,684	12,684	22	22
Total	75,341	75,341	44,564	44,564	82,647	82,647	108,086	108,086	1,393	1,393

BOSTON.[a]										
January	2,986	....	779	....	123,902	....	34,592	....	....	32
February	2,746	....	2,013	....	91,292	....	23,773	....	....	33
March	3,116	....	3,056	....	90,859	....	16,204	....	....	72
April	2,829	....	7,208	....	74,714	....	13,781	....	....	79
May	3,597	....	9,292	....	85,575	....	18,232	....	....	49
June	3,457	....	11,658	....	125,612	....	28,625	....	....	37
July	3,674	....	8,641	....	107,498	....	35,572	....	....	10
August	6,513	....	6,075	....	95,362	....	34,279	....	....	32
September	8,216	630	7,906	....	89,550	....	38,960	....	....	27
October	15,952	7,505	7,528	....	98,617	....	55,443	2,849	....	23
November	15,333	7,598	5,610	....	117,571	....	59,019	8,842	....	11
December	18,963	11,582	4,891	....	135,023	....	49,863	14,372	....	14
Total	87,182	27,315	74,657	....	1,235,575	....	407,343	26,063	....	419

[a]There were no exports of cattle and sheep until latter part of year on account of foot-and-mouth disease.

WEIGHTS AND PRICES OF LIVE STOCK.

Average weight of hogs, in pounds, for ten years, by months, at leading cities.

CHICAGO.

Month.	1903.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.
January	208	203	227	229	231	233	247	236	223	251
February	209	205	224	226	229	227	238	239	220	234
March	215	216	222	223	232	229	230	246	222	232
April	222	210	226	223	231	223	235	243	226	226
May	227	211	227	228	232	225	237	243	227	227
June	231	223	231	229	236	229	240	249	225	233
July	235	230	229	236	237	232	238	249	233	226
August	248	217	238	246	244	243	249	253	237	224
September	257	219	248	247	250	246	252	257	242	232
October	241	220	236	234	240	236	244	242	230	232
November	228	220	218	240	250	235	252	245	241	235
December	226	217	202	238	243	239	245	254	243	229
Average for year	226	216	226	233	237	234	242	246	230	233

KANSAS CITY.

Month.	1903.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.
January	224	172	213	230	216	218	224	238	216	226
February	220	176	210	218	207	212	225	231	213	220
March	218	188	207	210	208	211	216	232	213	216
April	223	194	207	207	209	209	216	226	213	211
May	215	196	210	213	213	209	217	222	211	212
June	211	198	205	213	209	210	220	221	212	209
July	213	205	187	206	211	217	219	214	213	215
August	216	209	187	219	211	219	217	216	209	199
September	232	208	185	214	211	218	218	226	212	203
October	223	217	199	213	215	215	210	229	220	208
November	211	223	179	216	230	211	221	238	227	220
December	220	224	173	218	222	208	217	232	235	221
Average for year	218	200	197	215	213	213	218	227	216	215

SIOUX CITY.

Month.	1903.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.
January	217	226	243	254	283	273	281	264	192	......
February	219	222	239	260	257	252	254	258	190	......
March	217	229	238	243	260	254	249	261	200	......
April	235	234	240	244	263	258	264	261	210	......
May	237	238	241	244	263	255	267	271	219	......
June	243	240	245	244	264	262	269	274	226	......
July	248	242	243	242	260	266	270	270	234	......
August	261	253	251	257	260	269	271	267	236	......
September	274	261	262	267	275	286	274	281	237	......
October	278	260	268	274	291	292	281	289	233	......
November	274	253	268	280	296	295	288	285	250	......
December	265	233	231	266	280	299	280	289	266	......
Average for year	247	241	249	258	272	271	278	274	224	......

Average weight of hogs, in pounds, for ten years, by months, at leading cities—Continued.

OMAHA.

Month.	1903.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.
January	242	209	234	257	262	287	275	275	194	259
February	235	211	231	237	245	263	269	268	199	245
March	236	220	232	243	247	260	269	261	211	238
April	247	228	232	236	247	260	269	262	217	242
May	248	230	234	237	251	257	271	268	217	240
June	253	232	242	239	250	260	272	273	222	238
July	254	233	231	234	248	263	269	272	226	234
August	265	242	236	239	246	259	270	272	219	208
September	273	253	246	249	256	265	274	282	238	196
October	278	259	250	245	259	274	286	288	246	210
November	268	262	235	253	270	279	290	289	261	219
December	265	256	212	252	268	274	299	291	269	197
Average for year	255	236	235	243	254	266	276	275	227	227

DENVER.

Month.	1903.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.
January	223	214	211	229	238	257	240	......	......	......
February	232	213	210	218	235	235	249	......	......	......
March	238	220	181	204	235	223	220	......	......	......
April	237	209	201	214	232	238	235	......	......	......
May	240	223	240	216	247	231	241	......	......	......
June	255	232	213	211	225	245	227	......	......	......
July	249	235	195	212	214	236	292	......	......	......
August	256	233	212	221	229	247	307	......	......	......
September	261	238	218	234	239	258	252	......	......	......
October	279	232	235	227	236	253	268	......	......	......
November	205	228	227	226	247	246	226	......	......	......
December	262	240	218	225	243	249	250	......	......	......
Average for year	245	226	213	220	235	243	250	......	......	......

Range of prices, per hundredweight, of cattle at Chicago and Omaha in 1903, by months, and annual range at Chicago since 1892.

CHICAGO.

Month.	Native steers (1,500-1,800 pounds).	Native steers (1,200-1,500 pounds).	Poor to choice cows and heifers.	Native stockers and feeders.	Texas and Western steers.
January	$4.50 to $6.75	$3.75 to $6.85	$3.25 to $5.35	$2.00 to $4.75	$3.60 to $4.75
February	4.30 to 6.15	3.60 to 6.00	3.50 to 4.75	2.35 to 4.75	2.95 to 4.35
March	4.60 to 5.75	4.00 to 5.75	3.60 to 5.15	2.50 to 5.15	3.75 to 4.65
April	4.80 to 5.65	4.20 to 5.80	3.40 to 5.40	2.50 to 5.20	3.75 to 5.10
May	4.50 to 5.60	4.10 to 5.65	3.70 to 5.25	2.50 to 5.20	3.15 to 4.80
June	4.70 to 5.60	4.25 to 5.65	3.50 to 5.20	2.25 to 5.00	3.15 to 4.75
July	4.70 to 5.65	4.30 to 5.60	3.25 to 5.50	2.25 to 4.65	2.75 to 5.10
August	4.70 to 6.00	4.00 to 6.10	3.50 to 5.35	2.15 to 4.35	2.75 to 5.00
September	4.70 to 6.10	3.75 to 6.15	3.40 to 5.50	2.00 to 4.40	2.65 to 4.70
October	4.55 to 5.90	3.75 to 6.00	3.25 to 5.25	1.65 to 4.25	2.85 to 4.25
November	4.30 to 5.75	3.35 to 5.85	2.60 to 5.25	1.50 to 4.40	2.55 to 3.65
December	4.10 to 7.55	3.35 to [a]8.35	2.50 to 5.25	1.50 to 4.20	3.65 to 4.00
Annual range:					
1903	4.10 to 7.55	3.35 to [a]8.35	2.50 to 5.50	1.50 to 5.20	2.55 to 5.10
1902	4.25 to [b]14.50	3.60 to 9.00	3.35 to 8.25	1.90 to 6.00	2.55 to 7.65
1901	4.75 to 9.30	3.60 to 12.00	2.00 to 8.00	1.65 to 5.15	2.75 to 5.75
1900	4.70 to [c]15.50	3.90 to 11.00	1.75 to 6.00	2.10 to 5.25	3.00 to 5.90
1899	4.60 to 8.50	4.00 to 8.25	2.00 to 6.85	2.50 to 5.40	3.10 to 6.75
1898	4.10 to 6.25	3.80 to 6.15	2.00 to 5.40	2.50 to 5.40	3.15 to 5.40
1897	4.00 to 6.00	3.35 to 6.00	1.75 to 5.40	2.40 to 4.75	2.75 to 4.90
1896	3.40 to 6.50	2.90 to 6.25	1.75 to 4.40	2.20 to 4.10	2.10 to 5.50
1895	3.60 to 6.60	2.90 to 6.40	2.00 to 5.75	2.25 to 5.15	2.25 to 5.75
1894	3.00 to 6.60	2.90 to 6.00	1.75 to 4.40	2.00 to 4.15	2.50 to 5.00
1893	4.00 to 6.75	2.90 to 6.50	2.00 to 5.00	2.25 to 4.90	3.50 to 6.00
1892	3.75 to 7.00	2.86 to 6.35	1.85 to 4.00	2.00 to 4.10	1.50 to 5.25

[a] The top price, $8.35, was attained by one load of yearling Hereford steers, averaging 1,099 pounds.
[b] One load of Aberdeen-Angus steers, averaging 1,510 pounds, sold at $14.50.
[c] Fifteen Aberdeen-Angus steers, averaging 1,492 pounds, sold at $15.50.

OMAHA.

Month.	Native beeves.	Native cows.	Stockers and feeders.	Western steers.	Western cows.
January	$3.35 to $5.10	$2.25 to $4.20	$2.45 to $4.50	$3.50 to $4.10	$2.25 to $3.55
February	3.15 to 5.15	2.20 to 4.20	2.65 to 4.50	....	....
March	3.45 to 5.35	2.25 to 4.50	2.50 to 4.80	4.00 to 4.65	....
April	3.20 to 5.25	2.50 to 4.95	2.75 to 5.00	....	....
May	3.85 to 5.10	2.40 to 4.55	3.25 to 4.90	....	....
June	3.75 to 5.30	2.10 to 4.75	3.00 to 4.70	4.00 to 4.40	2.25 to 2.85
July	3.65 to 5.35	2.25 to 4.60	2.50 to 4.25	3.50 to 4.30	2.35 to 4.20
August	3.85 to 5.75	2.00 to 4.30	2.25 to 4.00	3.25 to 4.50	1.70 to 3.50
September	3.60 to 5.75	1.90 to 4.10	2.00 to 4.30	2.25 to 4.35	1.80 to 3.20
October	3.90 to 5.50	1.25 to 4.30	2.00 to 4.10	2.35 to 4.50	1.40 to 3.40
November	3.00 to 5.30	1.55 to 3.65	2.45 to 4.15	2.60 to 4.60	1.65 to 3.15
December	2.65 to 5.30	1.70 to 3.65	2.60 to 3.85	2.40 to 4.00	1.85 to 3.15

Range of prices, per hundredweight, of hogs at Chicago and Omaha in 1903, by months, and annual range at Chicago since 1892.

CHICAGO.

Month.	Heavy packing (250–500 pounds).	Mixed packing (200–250 pounds).	Light bacon (150–200 pounds).
January	\$6.00 to \$7.10	\$5.80 to \$7.00	\$5.55 to \$6.80
February	7.00 to 7.55	6.20 to 7.40	5.95 to 7.15
March	7.00 to 7.87½	6.85 to 7.80	6.45 to 7.50
April	6.75 to 7.65	6.60 to 7.55	6.55 to 7.40
May	5.65 to 7.15	5.60 to 7.12½	5.35 to 6.95
June	5.50 to 6.45	5.55 to 6.40	5.45 to 6.25
July	4.50 to 5.90	4.90 to 6.00	5.15 to 6.10
August	4.40 to 5.85	4.80 to 6.05	5.00 to 6.20
September	4.85 to 6.35	5.20 to 6.45	5.55 to 6.40
October	4.50 to 6.30	4.75 to 6.50	4.75 to 6.50
November	3.85 to 5.40	3.90 to 5.50	3.90 to 5.45
December	4.10 to 4.90	4.10 to 4.90	4.00 to 4.77½
Annual range:			
1903	3.85 to 7.87½	3.90 to 7.80	3.90 to 7.70
1902	5.70 to 8.25	5.65 to 8.20	5.40 to 7.95
1901	4.80 to 7.37½	4.85 to 7.30	4.75 to 7.20
1900	4.15 to 5.85	4.15 to 5.82½	4.10 to 5.75
1899	3.35 to 4.95	3.40 to 5.00	3.30 to 5.00
1898	3.10 to 4.80	3.10 to 4.70	3.10 to 4.65
1897	3.00 to 4.45	3.20 to 4.50	3.20 to 4.65
1896	2.40 to 4.45	2.75 to 4.45	2.80 to 4.45
1895	3.20 to 5.45	3.25 to 5.55	3.25 to 5.70
1894	3.90 to 6.75	3.90 to 6.55	3.50 to 6.45
1893	3.80 to 8.75	4.25 to 8.65	4.40 to 8.59
1892	3.70 to 7.90	3.60 to 6.85	3.60 to 6.85

OMAHA.

Month.	Heavy packing (275–500 pounds).	Mixed packing (230–270 pounds).	Light bacon (150–225 pounds).
January	\$6.25 to \$6.85	\$6.30 to \$6.75	\$6.00 to \$6.70
February	6.70 to 7.20	6.65 to 7.05	6.35 to 7.05
March	7.00 to 7.55	6.95 to 7.45	6.75 to 7.40
April	6.80 to 7.40	6.75 to 7.30	6.60 to 7.25
May	5.70 to 6.90	5.67½ to 6.85	5.50 to 6.75
June	5.57½ to 6.20	5.55 to 6.10	5.50 to 6.05
July	4.90 to 5.65	4.92½ to 5.60	4.95 to 5.62½
August	4.92½ to 5.50	4.97½ to 5.60	5.00 to 5.80
September	5.05 to 5.80	5.20 to 5.85	5.15 to 6.00
October	4.80 to 5.72½	5.00 to 5.72½	5.05 to 5.85
November	4.10 to 5.00	4.15 to 5.05	4.15 to 5.25
December	4.20 to 4.70	4.25 to 4.60	4.15 to 4.62½

Range of prices, per hundredweight, of sheep at Chicago and Omaha in 1903, by months, and annual range at Chicago since 1892.

CHICAGO.

Month.	Native sheep (60–140 pounds).	Native yearlings and lambs.	Western sheep (70–140 pounds).	Western and Mexican lambs.
January	$1.50 to $5.25	$3.00 to $6.40	$2.50 to $5.25	$3.00 to $6.35
February	2.00 to 5.75	3.00 to 7.25	2.75 to 5.70	3.50 to 7.25
March	2.00 to 7.00	[a]3.25 to 7.85	2.75 to 7.00	[a]4.00 to 7.85
April	2.25 to 7.00	[a]3.50 to 8.00	2.60 to 6.90	[a]4.00 to 7.90
May	1.60 to 6.25	[a]2.75 to 7.50	2.40 to 5.95	[a]3.75 to 7.65
June	2.00 to 6.00	3.00 to 7.50	2.50 to 5.90	2.75 to 7.40
July	1.50 to 4.75	2.75 to 6.70	2.50 to 5.25	2.75 to 6.25
August	1.50 to 4.25	3.00 to 6.25	2.00 to 4.00	3.25 to 5.75
September	1.50 to 4.25	2.50 to 6.15	2.00 to 4.25	3.00 to 5.50
October	1.50 to 4.25	2.75 to 6.00	2.00 to 4.00	3.00 to 5.50
November	1.25 to 4.35	2.50 to 5.85	2.00 to 4.00	2.50 to 5.40
December	1.50 to 4.25	2.50 to 7.00	2.00 to 4.25	2.50 to 6.25
Annual range:				
1903	1.25 to 7.00	2.50 to 8.00	2.00 to 7.00	2.50 to 7.90
1902	1.25 to 6.50	2.00 to 7.25	1.25 to 6.30	2.50 to 7.60
1901	1.40 to 5.25	2.00 to 6.25	1.50 to 5.25	2.75 to 5.90
1900	2.00 to 6.50	3.00 to 7.60	3.00 to 6.50	4.00 to 7.60
1899	2.25 to 5.65	3.50 to 7.45	2.50 to 5.55	4.00 to 7.00
1898	2.00 to 5.25	3.50 to 7.10	3.00 to 5.25	3.75 to 6.75
1897	1.25 to 5.25	3.00 to 6.40	2.15 to 5.35	3.50 to 7.25
1896	1.00 to 4.60	2.75 to 6.50	2.15 to 4.30	3.50 to 6.25
1895	1.25 to 5.50	2.25 to 6.35	2.50 to 5.35	3.00 to 6.00
1894	1.00 to 5.40	2.00 to 6.00	2.00 to 5.40	2.50 to 5.80
1893	1.50 to 6.25	2.25 to 7.55	2.50 to 6.45	2.25 to 6.75
1892	2.25 to 6.90	3.00 to 8.25	3.00 to 6.75	3.50 to 7.25

[a] Spring lambs sold during 1903 as high as $13, with many at $7.50 to $10.

OMAHA.

Month.	Native sheep.	Native lambs.	Western sheep.	Western lambs.
January	$3.60 to $5.40	$3.75 to $6.00	....	....
February	4.50 to 5.80	4.00 to 6.60	....	....
March	4.60 to 6.75	5.40 to 7.35	....	....
April	4.50 to 6.75	[a]5.00 to 7.50	....	....
May	4.00 to 5.50	4.50 to 7.00	....	....
June	3.80 to 5.50	4.50 to 6.50	$2.50 to $4.50	$5.00 to $5.25
July	3.00 to 4.50	5.00 to 5.75	2.75 to 4.00	4.00 to 5.60
August	3.00 to 4.00	....	2.25 to 4.00	3.50 to 5.50
September	3.50	5.00 to 5.50	2.50 to 3.80	3.90 to 5.00
October	3.55	4.00 to 5.00	2.50 to 3.75	3.50 to 4.80
November	3.25 to 4.00	3.50 to 5.00	2.25 to 3.65	3.50 to 4.75
December	3.25 to 4.40	4.00 to 5.65	2.10 to 3.50	3.60 to 4.15

[a] Spring lambs (April), $12.

Range and average price of horses at Chicago and Omaha in 1903, by months, and annual average at Chicago since 1900.

CHICAGO.

Month.	Draft horses.	Carriage teams.	Drivers.	General use.	Bussers and trammers.	Saddlers.	Southern chunks.
January	$165	$425	$145	$120	$130	$155	$65
February	170	490	150	130	140	165	70
March	180	495	155	130	145	175	70
April	180	480	155	130	145	175	70
May	175	480	155	125	145	170	65
June	175	470	150	125	140	165	60
July	170	465	145	120	140	155	60
August	170	440	145	120	140	150	60
September	165	430	145	120	140	145	60
October	165	430	150	115	140	140	55
November	170	425	150	115	140	140	55
December	180	425	150	115	140	140	55
Annual average:							
1903	171	455	150	122	140	156	62
1902	166	450	145	117	135	151	57
1901	157	400	137	102	121	147	52
1900	155	410	140	105	115	150	50

OMAHA.

Month.	Draft horses.	Carriage teams.	Drivers.	General use.	Chunks.	Western.	Southern.
January	$90 to $175	$200 to $350	$95 to $225	$50 to $80	$70 to $120	$10 to $50	$35 to $70
February	95 to 185	200 to 350	95 to 225	60 to 100	70 to 120	10 to 50	35 to 75
March	100 to 200	200 to 400	100 to 230	60 to 110	80 to 130	10 to 50	35 to 70
April	100 to 250	200 to 500	100 to 250	60 to 110	80 to 140	10 to 50	30 to 65
May	110 to 250	250 to 550	100 to 350	65 to 105	80 to 140	12½ to 60	20 to 55
June	90 to 200	300 to 450	100 to 375	65 to 100	75 to 120	12½ to 65	15 to 40
July	90 to 175	200 to 400	75 to 275	50 to 80	60 to 110	10 to 65	15 to 45
August	90 to 175	210 to 420	75 to 220	45 to 80	60 to 110	10 to 90	15 to 45
September	90 to 175	215 to 360	95 to 200	40 to 80	65 to 110	10 to 100	15 to 45
October	100 to 180	200 to 435	90 to 215	40 to 80	65 to 110	10 to 100	20 to 45
November	90 to 160	225 to 370	100 to 325	45 to 85	65 to 120	10 to 80	20 to 60
December	100 to 185	200 to 375	100 to 300	45 to 85	70 to 125	12½ to 60	20 to 60

RULES AND REGULATIONS OF THE BUREAU OF ANIMAL INDUSTRY ISSUED IN 1903.

(AMENDMENT NO. 3 TO B. A. I. ORDER NO. 33.)

Regulations for the Inspection of Live Stock and Their Products.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 21, 1903.

It is hereby ordered, That section 4 of the Regulations for the inspection of live stock and their products, issued under date of March 15, 1899 (B. A. I. Order No. 33), be, and is hereby, amended by the addition of the following sentence to paragraph (b) of that section:

The slaughtering of animals shall be conducted on week days only, and between the hours of 6 a. m. and 7 p. m., unless permission is obtained from the Chief of the Bureau of Animal Industry in special cases to slaughter at other times.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 4 TO B. A. I. ORDER NO. 99.)

Quarantine of Cattle, Sheep, and other Ruminants, and Swine in the New England States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 23, 1903.

It is hereby ordered, That sheep and lambs may be shipped from the State of Vermont into the State of Massachusetts for immediate slaughter, in cases where the Chief of the Bureau of Animal Industry decides that it can be done with safety, and that such shipments shall be made in sealed cars, after inspection by an inspector of the Bureau of Animal Industry and upon permit issued by him.

The order of November 27, 1902 (B. A. I. Order No. 99), is amended in accordance herewith.

J. H. BRIGHAM, *Acting Secretary.*

(AMENDMENT NO. 5 TO B. A. I. ORDER NO. 99.)

Quarantine of Cattle, Sheep, and other Ruminants, and Swine in the New England States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., February 2, 1903.

It is hereby ordered, That animals may be shipped from the State of Vermont into the State of Massachusetts for immediate slaughter at Boston (including Brighton) and Somerville: *Provided,* That they shall not be unloaded en route nor at any public stock yard, nor be driven over any streets, but shall be taken by rail to an abattoir where inspection is maintained by this Department. The order of January 23, 1903 (Amendment No. 4 to B. A. I. Order No. 99), is hereby revoked.

It is further ordered, That the hides, skins, hair, horns, and hoofs of ruminants and swine may be taken out of the State of Vermont, subject only to the regulations of the States to which they are destined.

The order of November 27, 1902 (B. A. I. Order No. 99), and the order of December 13, 1902 (Amendment No. 2 to B. A. I. Order No. 99), are amended in accordance herewith.

J. H. BRIGHAM, *Acting Secretary.*

(AMENDMENT NO. 6 TO B. A. I. ORDER NO. 99.)

Removal of Quarantine upon Ruminants and Swine in the State of Rhode Island.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., May 9, 1903.

Whereas All animals affected with foot-and-mouth disease in the State of Rhode Island have been destroyed, and the premises occupied by them have been thoroughly disinfected, and it appears that the contagion of this disease is eradicated,

It is hereby ordered, That the quarantine upon cattle, sheep, and other ruminants and swine in Rhode Island, imposed by the order of November 27, 1902 (B. A. I. Order No. 99), be removed, and said animals and their products may be shipped or otherwise moved from that State without restrictions other than may be imposed by the authorities of the States to which said animals or products are destined.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 10 TO B. A. I. ORDER NO. 101.)

Regulations Concerning Cattle Transportation—Moving Cattle from Two Northern Tiers of Counties in Arkansas.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 12, 1903.

It is hereby ordered, That B. A. I. Order No. 101, dated December 26, 1902, be amended so as to permit the shipment of cattle for purposes other than immediate slaughter from the two northern tiers of counties in the State of Arkansas into the noninfected area: *Provided,* That said cattle have remained in the above-described counties since January 1 of this year and have been inspected by officers of the Bureau of Animal Industry of this Department and found to be free of splenetic, or Texas, fever, and not to have been exposed to the contagion thereof; that proper facilities have been afforded for making such inspection; and that after inspection the cattle shall be shipped without delay and without exposure to the infection of splenetic, or Texas, fever.

Provided further, That no cattle shall be allowed shipment under this order unless accompanied by a written permit issued by an inspector of the Bureau of Animal Industry, nor shall such cattle be taken into any State or Territory contrary to the local regulations; and said permission will be granted only for cattle which are to remain within the State to which destined for three months after arrival.

This order to remain in force until April 1, 1903.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 11 TO B. A. I. ORDER NO. 101.)

Regulations Concerning Cattle Transportation—Permitting Movement of Cattle from Part of Ponca Indian Reservation.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., February 21, 1903.

It is hereby ordered, That section 3 of B. A. I. Order No. 101, dated December 26, 1902, be amended so as to permit the shipment of cattle for other purposes than immediate slaughter to points in the noninfected area from that portion of the Ponca Indian Reservation, Oklahoma, east of the right of way of the Atchison, Topeka and Santa Fe Railway and bounded on the east and north by the Arkansas River and the Salt Fork of the Arkansas River: *Provided,* That said cattle have been kept in the above-described area since January 1, 1903, and have been inspected by an officer of the Bureau of Animal Industry of this Department and found free of splenetic, or Texas, fever and not to have been exposed to the contagion thereof.

And provided further, That no cattle shall be allowed shipment from this area unless accompanied by a written permit issued by an officer of the Bureau of Animal Industry, and all such cattle shall be subject to the laws and regulations of the State to which destined. The cars in which such cattle are shipped must be free from infection and satisfactory to the officer supervising the shipment.

This order to terminate April 30, 1903.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 102.)

Transportation of Horses Affected with Maladie du Coït.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., January 20, 1903.

To the managers and agents of railroads and transportation companies, stockmen, and others in the States of South Dakota and Nebraska:

In accordance with sec. 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and with the act of Congress approved June 3, 1902, making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1903, you are hereby notified that an infectious venereal disease, known as maladie du coït of horses, exists among the horses in the counties of Dawes, Boxbutte, Sheridan, and Cherry, in the State of Nebraska, and in the Pine Ridge and Rosebud Indian reservations and the counties of Custer and Fall River, in the State of South Dakota.

It is a violation of law to receive for transportation or to transport any horses affected with said disease from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia, or to deliver for such transportation any horses knowing them to be affected with said disease, or to drive on foot or transport in private conveyance from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia any horses knowing them to be affected with the said disease. In order to effectually accomplish the object of the above-named laws and to prevent the dissemination of said disease and to aid in its extermination,

It is hereby ordered, That no horses shall be offered for shipment or be transported, or driven, or trailed, or otherwise removed from any of the above-named counties or reservations unless they shall have been inspected by an inspector of the Bureau of Animal Industry of this Department and shall be accompanied by a certificate of inspection issued by said inspector. The owners or shippers for whom the inspection is made shall provide such facilities and render such assistance as may be required by the inspector.

All persons engaged in raising horses, or in dealing in or in driving or shipping horses, and all transportation companies are requested to cooperate with this Department in enforcing the law for preventing the spread of said disease. Inspectors of the Bureau of Animal Industry are directed to report all violations of this order which come to their attention.

J. H. BRIGHAM, *Acting Secretary.*

(AMENDMENT NO. 1 TO B. A. I. ORDER NO. 102.)

Transportation of Horses in Certain Counties of Nebraska, South Dakota, and the Pine Ridge and Rosebud Indian Reservations.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., Septemher 15, 1903.

It is hereby ordered, That B. A. I. Order No. 102, dated January 20, 1903, be so amended as to permit the shipment of horses from the county of Boxbutte, and portions of the counties of Dawes, Sheridan, and Cherry, lying south of the Chicago and Northwestern Railroad (formerly Fremont, Elkhorn and Missouri Valley Railroad), without inspection by an inspector of the Bureau of Animal Industry of this Department: *Provided,* That the said horses, being either stallions or mares, have not been north of the above railroad in the counties of Dawes, Sheridan, and Cherry, State of Nebraska, or into the Pine Ridge or Rosebud Indian Reservations, or the counties of Custer and Fall River, S. Dak., since May 1st of this year; and that the restrictions imposed by this Department upon the movement of horses from the above-named territory, except as herein provided, are hereby removed.

J. H. BRIGHAM, *Acting Secretary.*

(B. A. I. ORDER NO. 103.)

Quarantine of Cattle, Sheep, and Other Ruminants, and Swine in the State of New Hampshire.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 7, 1903.

To the managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In pursuance of section 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to

provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and of the act of Congress approved June 3, 1902, making appropriations for the fiscal year ending June 30, 1903, and of the act of Congress approved February 2, 1903, entitled "An act to enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of live stock and for other purposes," notice is hereby given that a contagious and infectious disease, known as foot-and-mouth disease, exists among animals in the State of New Hampshire, and that the cattle, sheep, and other ruminants, and swine in said State have been exposed to the contagion of said disease: Therefore,

It is hereby ordered, That to prevent the spread of said disease from the State of New Hampshire into other States or foreign countries, and to aid in its eradication, no cattle, sheep, or other ruminants, or swine shall be moved or be permitted to move from or across said State: *Provided*, That said animals may be shipped from points outside of the States quarantined on account of this disease across New Hampshire for the purpose of immediate slaughter, when they are shipped in cars sealed by inspectors of the Department of Agriculture and are not unloaded while within said State; and that the seals on the cars carrying said animals shall not be broken except at their destination; and that the movement of the animals shall be so arranged that the time of their confinement in the cars shall not exceed the limit fixed by law.

It is further ordered, That all cars which have carried animals into or within the limits of said State shall be cleaned and disinfected before leaving said State: *Provided*, That where there are no facilities for disinfection, or when the condition of the weather prevents its proper accomplishment, such cars may be allowed to go out without disinfection if they are sealed at the time of unloading by an inspector of this Department and said seal is not broken until after arrival in uninfected territory.

The cleaning and disinfection shall be done in the following manner: First, clean the car thoroughly; then the entire interior surface of the car is to be thoroughly washed with a mixture of $1\frac{1}{4}$ pounds of lime and 7 ounces of 100 per cent carbolic acid to each gallon of water or of the same quantity of lime with 7 ounces of chloride of lime to each gallon of water. If the work is supervised by an inspector of this Department, instead of using the foregoing mixtures, the disinfection may be done with a jet of steam under a pressure of not less than 50 pounds to the square inch. The litter and manure taken from cars that have carried animals within the limits of said States shall be disinfected by mixing them with lime or saturating them with a 5 per cent solution of 100 per cent carbolic acid.

It is further ordered, That the hides, skins, hair, wool, horns, or hoofs of ruminants or swine shall not be allowed to be taken out of said State.

Any person, company, or corporation violating this order will be proceeded against as provided by act of Congress.

JAMES WILSON, *Secretary*.

(B. A. I. ORDER NO. 104.)

Special order providing for the importation of Canadian animals for exhibition at the Louisiana Purchase Exposition at St. Louis, Mo.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 9, 1903.

It is hereby ordered, That Canadian animals, including horses, cattle, sheep, goats, and swine may be imported into the United States for exhibition at the Louisiana Purchase Exposition provided they are accompanied by a certificate of a Canadian official veterinarian stating that such animals are free from any contagious or infectious diseases and have not been exposed to the contagion of such diseases affecting each particular species for a period of three months preceding the date of shipment. All such animals must be loaded at point of shipment in Canada into clean and disinfected cars for transportation to the United States, and a certificate from the railroad agent must accompany said cars, showing that they were duly cleaned and disinfected in the manner prescribed in the regulations of this Department. Such animals must be entered at one of the designated animal quarantine stations (principal stations: St. Albans, Vt., Buffalo, N. Y., Detroit, Mich., and Port Huron, Mich.), and on their arrival the inspector of the Bureau of Animal Industry at said station will countersign the official veterinary certificate (or permit in the case of cattle) herein provided for and allow the animals, if found free from disease, to proceed to St. Louis subject to veterinary inspection at that point. All such Canadian animals must be loaded and shipped in cars in which they can and do have proper food, water, space, and opportunity to rest, and must not be unloaded in any public stock yards or other point until they reach the exposition grounds at St. Louis.

Any person contemplating the importation of neat cattle from Canada must make application to this Department for a permit to import cattle for that purpose; said application must give the number of cattle and a description of each, covering breed, registration number, and state at what point the cattle are to be imported; the names of the railroads by which and over which said cattle are to be transported to the city of St. Louis. This application must be accompanied by a certificate from a Canadian official veterinarian, stating that no contagious disease affecting cattle, excepting tuberculosis and actinomycosis, has existed in the district in which such cattle have been kept for the past year, and that the cattle have been examined by him and are free from contagious diseases.

The cattle of Canadian origin which are not sold to remain in the United States must be returned immediately to Canada at the close of the exposition. All such cattle that are to remain in the United States must be tested with tuberculin by an inspector of the Bureau of Animal Industry, and will not be allowed shipment to destination in the United States unless such test shows them to be free from tuberculosis.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 105.)

Special Order Providing for the Importation of Animals (other than Canadian) for Exhibition at the Louisiana Purchase Exposition, St. Louis, Mo.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 9, 1903.

It is hereby ordered, That horses from Great Britain and the Continent of Europe may be imported into the United States for exhibition at the Louisiana Purchase Exposition, provided they pass a veterinary inspection by an inspector of the Bureau of Animal Industry at the port of entry.

It is further ordered, That the quarantine period for cattle imported for this exposition from Great Britain, Ireland, and the Channel Islands shall be sixty days, counting from the date of shipment. The period of quarantine for sheep, other ruminants, and swine shipped from the above countries shall be fifteen days, counting from the date of arrival at the port of entry.

Any person contemplating the importation of cattle, sheep, and other ruminants, and swine for exhibition at this exposition must make application to this Department for a permit to import and quarantine said animals for that purpose. This application must state the number and kind of animals to be imported, the port from which shipped, and probable date of shipment, and must further state the port at which said animals are to be landed and quarantined and the approximate date of their arrival. United States consuls will not give clearance papers or certificates for the shipment of animals from their districts unless the importer presents a duly signed permit issued by this Department covering the shipment.

The regulations of this Department—B. A. I. Order No. 56, dated December 28, 1899—will govern generally the care and supervision of such animals in their shipment from the port of entry to the animal quarantine station and after arrival at such station. The certificates of health provided for in the above regulations will also be required for animals imported for this exposition. All cattle covered by the provisions of this order may be imported without a tuberculin test, provided that after the expiration of the quarantine period they are shipped direct from the animal quarantine station to the exposition grounds without unloading in any public stock yards or other point en route. After the close of the exposition, however, if such cattle are to remain in the United States, they must be tested with tuberculin by an inspector of the Bureau of Animal Industry and will not be allowed shipment to destination in the United States unless such test shows them to be free from tuberculosis.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 106.)

Regulations for the Suppression and Extirpation of Contagious and Infectious Diseases among Domestic Animals in the United States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 10, 1903.

In pursuance of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and of the act of Congress approved February 2, 1903, entitled "An act to enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of live stock, and for other purposes," the following regulations are adopted for the control and eradication of said diseases:

1. All persons owning, managing, or transporting animals are required to exercise reasonable diligence to ascertain that the animals are not affected with any contagious or infectious disease and have not been exposed to the contagion of said disease by contact with other animals so affected or by being in or upon pens, premises, cars, or other vehicles contaminated by diseased animals, before

offering them for transportation or transporting them, or introducing them into public stock yards or upon public highways or lines of interstate traffic. All persons having charge of animals so affected or exposed are required to keep them confined, and they shall not permit other animals to come in contact with them. No person controlling premises or vehicles where diseased or exposed animals have been shall allow them to be occupied by healthy animals until the danger of infection is removed.

2. Whenever there exists a contagious or infectious disease among animals in any State or Territory or the District of Columbia, said State or Territory or District shall be considered an infected locality; and all animals susceptible to said disease in said State or Territory or District shall be considered as having been exposed to the contagion of said disease and dangerous to other animals and shall not be removed or allowed to move from said locality, except as may be provided by orders issued by the Secretary of Agriculture.

3. The movement of susceptible animals into or through any infected locality shall be governed by these regulations and such additional orders as may be issued from time to time by the Secretary of Agriculture for the control of different diseases.

4. Cars, boats, or other vehicles used for the transportation of susceptible animals into, within, or from said infected locality shall be cleaned and disinfected in the manner prescribed by orders of the Secretary of Agriculture.

5. Public stock yards, feeding stations, their approaches, chutes, alleys, and pens, when contaminated by the presence of animals affected with or exposed to the contagion of a contagious or infectious disease, shall be cleaned and disinfected and arranged as may be required by the Secretary of Agriculture. For failure to comply with said requirements, said places will be quarantined and all movement of live stock therefrom will be prohibited, in order to protect the animal industry of the country.

6. The shipment or removal of hay, straw, forage, or similar material, or any meats, hides, or other animal products from an infected locality shall be prohibited when deemed necessary to prevent the dissemination of disease, and will be governed by the orders that may be issued by the Secretary of Agriculture, and such articles and products shall be seized, quarantined, or otherwise disposed of, when necessary, to guard against the spread of contagion.

7. When deemed necessary, shipments of live stock and of the articles and products named in the last preceding paragraph will be stopped in transit for the purpose of inspection, and when found affected with a contagious or infectious disease or liable to disseminate the contagion thereof they and the vehicle conveying them shall be disposed of as provided by these regulations and by such other orders as may be issued by the Secretary of Agriculture.

8. Where a contagious or infectious disease exists in a foreign country, no animals susceptible to said disease, or the meats, hides, or other products of such animals, or hay, straw, forage, or similar material, originating in or passing through such country, shall be admitted into the United States when said importation would endanger the live-stock industry of the United States. When importations of said animals or products are permitted they shall be governed by the orders that may be issued by the Secretary of Agriculture, and such products and articles shall be seized, quarantined, or otherwise disposed of when necessary to guard against the introduction or spread of contagion.

9. Where the disease is confined to a limited portion of a State or Territory that portion only may be quarantined, provided the State or Territorial officers have authority to enforce said quarantine locally and to cooperate with the Department of Agriculture, and provided further that such restricted quarantine is deemed sufficient for the control of the disease.

10. Where the authorities of a State or Territory in which any of said diseases exists signify a willingness to cooperate with and adopt the methods and regulations of the Department of Agriculture for the extermination of the disease, or where the methods and regulations of the State or Territory are accepted by the Secretary of Agriculture, he may direct the Chief of the Bureau of Animal Industry to enforce quarantine measures and to take other necessary steps within the State or Territory to prevent the dissemination of the disease and for its control and eradication.

11. Where it becomes necessary to slaughter any animal affected with, or exposed to the contagion of, a contagious or infectious disease in order to exterminate the disease, the value of the animal slaughtered or to be slaughtered shall be ascertained and compensation made therefor by agreement with the owner or by appraisement in the manner provided by the law of the State or Territory wherein the animal is held. In the absence of such law the appraisal and compensation shall be as prescribed by the Secretary of Agriculture for the disease for the eradication of which the animal is condemned to be slaughtered. Where the owner refuses to accept the compensation so determined he may bring suit against the United States in the manner provided by law.

12. Violation of these regulations or other orders of the Secretary of Agriculture relating to contagious and infectious diseases of animals is punishable by a fine of not less than one hundred dollars nor more than one thousand dollars, or by imprisonment not more than one year, or by both such fine and imprisonment.

13. The regulations dated April 15, 1887, are hereby revoked.

JAMES WILSON, *Secretary*.

[PUBLIC—No. 49.]

AN ACT To enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of live stock, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to enable the Secretary of Agriculture to effectually suppress and extirpate contagious pleuro-pneumonia, foot-and-mouth disease, and other dangerous contagious, infectious, and communicable diseases in cattle and other live stock, and to prevent the spread of such diseases, the powers conferred on the Secretary of the Treasury by sections four and five of an act entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," approved May twenty-ninth, eighteen hundred and eighty-four (twenty-third United States Statutes, thirty-one), are hereby conferred on the Secretary of Agriculture, to be exercised exclusively by him. He is hereby authorized and directed, from time to time, to establish such rules and regulations concerning the exportation and transportation of live stock from any place within the United States where he may have reason to believe such diseases may exist into and through any State or Territory, including the Indian Territory, and into and through the District of Columbia and to foreign countries, as he may deem necessary, and all such rules and regulations shall have the force of law. Whenever any inspector or assistant inspector of the Bureau of Animal Industry shall issue a certificate showing that such officer had inspected any cattle or other live stock which were about to be shipped, driven, or transported from such locality to another, as above stated, and had found them free from Texas or splenetic fever infection, pleuro-pneumonia, foot-and-mouth disease, or any other infectious, contagious, or communicable disease, such animals so inspected and certified, may be shipped, driven, or transported from such place into and through any State or Territory, including the Indian Territory, and into and through the District of Columbia, or they may be exported from the United States without further inspection or the exaction of fees of any kind, except such as may at any time be ordered or exacted by the Secretary of Agriculture; and all such animals shall at all times be under the control and supervision of the Bureau of Animal Industry of the Agricultural Department for the purposes of such inspection.

SEC. 2. That the Secretary of Agriculture shall have authority to make such regulations and take such measures as he may deem proper to prevent the introduction or dissemination of the contagion of any contagious, infectious, or communicable disease of animals from a foreign country into the United States or from one State or Territory of the United States or the District of Columbia to another, and to seize, quarantine, and dispose of any hay, straw, forage, or similar material, or any meats, hides, or other animal products coming from an infected foreign country to the United States, or from one State or Territory or the District of Columbia in transit to another State or Territory or the District of Columbia whenever in his judgment such action is advisable in order to guard against the introduction or spread of such contagion.

SEC. 3. That any person, company, or corporation knowingly violating the provisions of this act or the orders or regulations made in pursuance thereof shall be guilty of a misdemeanor, and on conviction shall be punished by a fine of not less than one hundred dollars nor more than one thousand dollars, or by imprisonment not more than one year, or by both such fine and imprisonment.

Approved, February 2, 1903.

(B. A. I. ORDER NO. 107.)

Regulations to Prevent the Spread of Splenetic Fever of Cattle.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 13, 1903.

To managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In furtherance of the regulations for the suppression and extirpation of contagious and infectious diseases among domestic animals in the United States, dated March 10, 1903 (B. A. I. Order No. 106), notice is hereby given that a contagious and infectious disease known as splenetic, southern, or Texas fever exists among cattle in the district described below:

1. All that country lying south or below a line beginning at the northwest corner of the State of California; thence east, south, and southeasterly along the boundary line of said State of California to the southeastern corner of said State; thence southerly along the western boundary line of Arizona to the southwest corner of Arizona; thence along the southern boundary lines of Arizona and New Mexico to the southeastern corner of New Mexico; thence northerly along the eastern boundary of New Mexico to the southern line of the State of Colorado; thence along the southern boundary lines of Colorado and Kansas to the southeastern corner of Kansas; thence southerly along the western boundary line of Missouri to the southwestern corner of Missouri; thence easterly along the southern boundary line of Missouri to the western boundary line of Dunklin County; thence southerly along the said western boundary to the southwestern corner of Dunklin County; thence easterly along the southern boundary line of Missouri to the Mississippi River; thence northerly along the Mississippi River to the northern boundary line of Tennessee at the northwest corner of Lake County; thence easterly along said boundary line to the northeast corner of Henry County; thence in a northerly direction along the boundary of Tennessee to the northwest corner of Stewart County; thence in an easterly direction along the northern boundary of Tennessee to the southwestern corner of Virginia; thence northeasterly along the western boundary line of Virginia to the northernmost point of Vir-

ginia; thence southerly along the eastern boundary line of Virginia to the northeast corner of Virginia, where it joins the southeastern corner of Maryland at the Atlantic Ocean.

2. Whenever any State or Territory located above or below said quarantine line, as above designated, shall duly establish a different quarantine line, and obtain the necessary legislation to enforce said last-mentioned line strictly and completely within the boundaries of said State or Territory, and said last above-mentioned line and the measures taken to enforce it are satisfactory to the Secretary of Agriculture, he may, by a special order, temporarily adopt said State or Territorial line.

Said adoption will apply only to that portion of said line specified, and may cease at any time the Secretary may deem it best for the interests involved, and in no instance shall said modification exist longer than the period specified in said special order; and at the expiration of such time said quarantine line shall revert without further order to the line first above described.

Whenever any State or Territory shall establish a quarantine line, for above purposes, differently located from the above-described line, and shall obtain by legislation the necessary laws to enforce the same completely and strictly, and shall desire a modification of the Federal quarantine line to agree with such State or Territorial line, the proper authorities of such State or Territory shall forward to the Secretary of Agriculture a true map or description of such line and a copy of the laws for enforcement of same, duly authenticated and certified.

3. No cattle are to be transported from said area south, or below, said Federal quarantine line above described to any portion of the United States above—north, east, or west of—the above-described line, except as hereinafter provided.

4. Cattle from said area may be transported by rail or boat for immediate slaughter, and when so transported the following regulations must be observed:

(*a*) When any cattle in course of transportation from said area are unloaded above—north, east, or west of—this line to be fed or watered, or for other purposes, said cattle shall be placed in pens or yards set apart for infected cattle, and no other cattle shall be admitted thereto.

(*b*) On unloading said cattle at their points of destination, chutes, alleyways, and pens, sufficiently isolated, shall be set apart to receive them, and no other cattle shall be admitted to said chutes, pens, and alleyways; and the regulations relating to the movement of cattle from said area, prescribed by the cattle sanitary officers of the State where unloaded, shall be carefully observed. The cars or boats that have carried said stock shall be cleansed and disinfected as soon as possible after unloading and before they are again used to transport, store, or shelter animals or merchandise.

(*c*) Where Southern cattle and cattle originating outside of the quarantined district are yarded in adjacent pens, there shall be left a space between them not less than ten feet wide, and there shall be on each side of this space, which shall not be used for cattle, a tight board fence not less than five feet high.

(*d*) All cars carrying cattle from said area shall bear on both sides printed placards, the letters of which shall be plain and not less than $1\frac{1}{2}$ inches in height, to be affixed by the railroad company hauling the same, stating that said cars contain southern cattle; and each of the waybills, conductor's manifests, and bills of lading of said shipments by cars or boats shall have a note plainly written or stamped upon its face with a similar statement. The placards shall state the name of the place from which the shipment was made, with the date and the name of the place of destination; said date must correspond with the date of the waybill and other papers. Whenever any cattle have come from said area and shall be reshipped from any point at which they have been unloaded to other points of destination the cars carrying said animals shall bear on both sides similar placards with like statements, and the waybills, conductor's manifests, or bills of lading be so stamped. At whatever point these cattle are unloaded they must be placed in separate pens, to which no other cattle shall be admitted.

(*e*) No boat having on board cattle from said district shall receive on board cattle from outside of said district. Cattle from said district shall not be received on board when destined to points outside of said district where proper facilities have not been provided for transferring the said cattle from the landing to the stock yards and slaughterhouses without passing over public highways, unless permission for such passing is first obtained from the local authorities.

(*f*) The cars and boats used to transport such animals, the chutes, alleyways, and pens used during transportation and at points of destination shall be disinfected in the following manner:

Remove all litter and manure. This litter and manure may be disinfected by mixing it with lime or saturating it with a 5 per cent solution of 100 per cent carbolic acid; or, if not disinfected, it may be stored where no cattle can come in contact with it during the period from February 1 to November 15 of each year.

Wash the cars and the feeding and watering troughs with water until clean.

Saturate the entire interior surface of the cars and the fencing, troughs, chutes, and floors of the pens with a mixture made of $1\frac{1}{2}$ pounds of lime and one-quarter pound of 100 per cent straw-colored carbolic acid to each gallon of water, or a solution made by dissolving 4 ounces of chloride of lime to each gallon of water may be used; or disinfect the cars with a jet of steam under a pressure of not less than 50 pounds to the square inch.

(*g*) Cars which have carried cattle within the quarantined district shall be cleaned and disinfected before being taken out of said district, except when loaded with cattle in course of transportation in accordance with these regulations.

5. Cattle from the Republic of Mexico may be admitted into the United States, after inspection according to law, as follows:

Cattle free from splenetic, or Texas, fever and from contact therewith during the six months preceding such inspection, and which have been grazed in a locality free from infection of such fever, may be admitted into any part of the United States. If destined to points in the noninfected area, a special permit must be obtained from an inspector of the Bureau of Animal Industry, said permit being issued according to the regulations of said Bureau. The cattle for which said permit is issued must not be driven through the infected area nor be unloaded in any part thereof except at such a point as may be duly designated by an order issued by this Department. If shipped in infected cars or unloaded in the infected area, except as above stated, they will be subject to the regulations concerning infectious cattle.

6. Notice is hereby given that cattle infested with the *Boophilus annulatus* (*B. bovis*), or Southern cattle tick, disseminate the contagion of splenetic, southern, or Texas fever; therefore, cattle originating outside of the district described by this order or amendments thereof, and which are infested with the *Boophilus annulatus* ticks, shall be considered as infectious cattle and shall be subject to the rules and regulations governing the movement of southern cattle.

7. Stock-yard companies receiving cattle infested with said ticks shall place such cattle in the pens set aside for the use of Southern cattle; and transportation companies are required to clean and disinfect all cars and boats which have contained the same, according to the requirements of this Department.

8. Inspectors are instructed to see that disinfection is properly done, and to report instances of improper disinfection and other violations of this order.

9. Violation of these regulations is punishable by a fine of not less than one hundred dollars nor more than one thousand dollars, or by imprisonment not more than one year, or by both such fine and imprisonment.

10. These regulations supersede B. A. I. Order No. 101 and amendments thereto.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 1 TO B. A. I. ORDER NO. 107.)

Special Order Modifying Quarantine Line for the State of California. (1903.)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

In accordance with the regulations to prevent the spread of splenetic fever of cattle, the State of California has agreed to establish and cooperate in the enforcement of a quarantine line located as follows:

Beginning on the Pacific coast where the northern boundary line of Monterey County connects with the Pacific Ocean; thence easterly and southerly along the northern and eastern boundary line of Monterey County to its junction with the western boundary of Fresno County; thence northerly along the western boundary of Fresno County to the western corner thereof; thence northerly, easterly, and southerly along the western, northern, and eastern boundary line of Merced County to the southeast corner thereof; thence northeasterly along the northern boundary of Madera County to the northeast corner thereof; thence southerly and easterly along the eastern boundary lines of Madera, Fresno, and Tulare counties to the southeast corner of Tulare County; thence easterly along the southern boundary line of Inyo County to its intersection with the eastern boundary line of the State of California.

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of California to enforce said quarantine line, therefore the above quarantine line is adopted for the State of California by this Department for the period beginning with the date of this order and ending December 31, 1903, in lieu of the quarantine line described in the order of March 13, 1903, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle originating in the quarantined area as described in B. A. I. Order No. 107, as modified, shall be moved or allowed to move into the counties of Kern, Tulare, Kings, Monterey, Fresno, Madera, and Merced; and that cattle now in said counties may be moved to points outside of the quarantined area for purposes other than immediate slaughter upon inspection and certification that they are free of infection by a duly authorized officer of the county board of supervisors, and that said certificate be approved and signed by the State veterinarian. This privilege is granted upon condition that the board of supervisors in each of said counties adopt and enforce efficient measures to prevent the introduction into and the dissemination within the county of the contagion of southern cattle fever, and that it prosecute measures for the eradication of said disease.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 2 TO B. A. I. ORDER NO. 107.)

Special Order Modifying Quarantine Line for the State of Texas. (1903.)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

In accordance with the regulations to prevent the spread of splenetic fever of cattle, the State of Texas has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

Beginning at the intersection of the southern boundary of New Mexico with the international boundary line at the Rio Grande River, thence southeasterly along the said international boundary line to the southwest corner of the county of Pecos; thence following the western boundary of Pecos County to the southeast corner of Reeves County; thence following the boundary line between the counties of Pecos and Reeves to the Pecos River; thence southeasterly, following the Pecos River, to the northwest corner of Crockett County; thence east along the northern boundary of Crockett and Schleicher counties to the southeastern corner of Irion County; thence north along the eastern boundary of Irion County to the northeast corner of said county; thence continuing due north to the southern boundary line of Coke County; thence west with the southern boundary of Coke County to the southwest corner of Coke County; thence north along the western boundary of Coke County to the southern boundary of Mitchell County; thence east to the southeast corner of Mitchell County; thence north along the eastern boundary of Mitchell County to the northeast corner of said county; thence east along the southern boundaries of Fisher and Jones counties to the southeast corner of Jones County; thence north along the eastern boundary of Jones County to the northeast corner of said county; thence east along the southern boundary of Haskell County to the southeast corner of said county; thence north along the western boundary lines of Throckmorton and Baylor counties to the northwest corner of Baylor County; thence east along the southern boundary of Wilbarger County to the southeast corner of said county; thence north along the eastern boundary of Wilbarger County to the Red River; thence continuing in a northwesterly direction along the course of said river and the northern boundary of Texas to the southeast corner of Greer County, Oklahoma Territory.

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of Texas to enforce said quarantine line, therefore the above quarantine line is adopted for the State of Texas by this Department for the period beginning with the date of this order and ending December 31, 1903, in lieu of the quarantine line described in the order of March 13, 1903, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle originating in the quarantined area as described in B. A. I. Order No. 107, as modified, shall be moved or allowed to move into the counties of Baylor and Throckmorton, and that portion of the county of Pecos lying north and west of the line described as follows: Beginning at the west line of Pecos County, at the point where the roadbed of the G. H. & S. A. Railroad crosses said line; thence in an easterly direction with the center of said roadbed to a point on section No. 36, block A2, G. H. & S. A. Railroad Company; thence north with the pasture fence running in a northerly direction through the eastern part of sections Nos. 13 and 12 of said block A2, and across section No. 1, G. C. & S. F. Railroad Company; thence continuing north with said pasture fence through the eastern part of sections Nos. 16, 17, 46, 47, 76, 77, 106, 107, 136, 137, 142, 143, and 194, Block D, M. K. & T. E. Railroad Company; thence continuing in a northerly direction to a point on the north line of section No. 6, block 160, G. C. & S. F. Railroad Company, same being corner of pasture fence; thence east with the north line of sections Nos. 6, 9, 10, 11, 12, 15, 16, block 160, G. C. & S. F. Railroad Company, to the northeast corner of said section No. 16, same being corner of pasture fence; thence in a northerly direction with the east boundary line of sections Nos. 22, 21, 20, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, block 1, C. C. S. D. & R. G. N. G. Railroad Company, to the northeast corner of said section 32; thence west with the north boundary line of sections Nos. 32 and 33, same block, to the northwest corner of section No. 33, block 1, C. C. S. D. & R. G. N. G. Railroad Company, corner of fence; thence north with the east boundary line of sections Nos. 1, 12, 13, 24, 25, 36, 37, 48, 49, 60, 61, and 72, block 2, C. C. S. D. & R. G. N. G. Railroad Company, to the northeast corner of said section No. 72; thence in an easterly direction with the pasture fence to the southeast corner of section No. 9, patented to James E. Evans; thence north with the east line of said section No. 9 to the northwest corner of section No. 100, block A2, T. C. Railroad Company; thence east with north boundary line of said sections Nos. 100 and 89, same block, to the northeast corner of said section No. 89, block A2, T. C. Railroad Company; thence north with the east boundary line of sections Nos. 90, 91, 92, and 93 to the southeast corner of section No. 94, block A2, T. C. Railroad Company; thence northwest diagonally across section No. 94 to the northwest corner of said section; thence continuing in a northwesterly direction, diagonally across sections Nos. 14, 18, and 28, to the northeast corner of section No. 29, block C4, G. C. & S. F. Railroad Company; thence west with the north boundary line of said section No. 29 to the northwest corner of said section; thence northwest diagonally across section No. 1, T. C. Railroad Company, section No. 97, block No. 194, G. C. & S. F. Railroad Company, to the northeast corner of said section No. 96; thence in a northerly direction across section No. 94 to a point on its north boundary line 600 varas west of its northeast corner; thence continuing north through sections Nos. 93, 90, 89, 86, 85, and 58, block 194, G. C. & S. F. Railroad Company, to a point on the north boundary line of said section No. 58; thence northwesterly with the pasture fence, through section 59, to the northeast corner of section No. 82 and the southeast corner of section No. 81, same block; thence continuing northwesterly to

section No. 17, H. & G. N. Railroad Company; thence north with the east line of said section 17 to the Pecos River; thence northwesterly with said Pecos River to the northwest corner of Crockett County.

And it is further ordered, That no cattle shall be moved or allowed to move from the counties of Cottle, Hardeman, Foard, Wilbarger, King, Knox, Haskell, Stonewall, Jones, Fisher, Scurry, Garza, Borden, Howard, Mitchell, Glasscock, Sterling, Irion, West Tom Green, Upton, Crane, Throckmorton, and Baylor, and that portion of the county of Pecos as described above, to any of that territory in the State of Texas lying west and north of said counties, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the State of Texas, and upon written permission by such officer. No cattle from said counties shall be moved or allowed to move to any State or Territory outside of the quarantined district (except as provided for immediate slaughter) unless they have been duly inspected and passed, and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which said cattle are destined.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 3 TO B. A. I. ORDER NO. 107.)

Special Order Modifying Quarantine Line for the Territory of Oklahoma. (1903.)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

In accordance with the regulations to prevent the spread of splenetic fever of cattle, the Territory of Oklahoma has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

Beginning on the Red River at the southeastern corner of the county of Greer; thence northerly following the course of the North Fork of the Red River to its intersection with the southern boundary line of Roger Mills County; thence east along the southern boundary lines of Roger Mills and Washita counties to the southeast corner of Washita County; thence north along the eastern boundary lines of Washita and Custer counties to the Canadian River; thence in a southeasterly direction along the course of said river to the southeast corner of Canadian County; thence north along the eastern boundary line of Canadian County to the northwest corner of Cleveland County; thence east along the northern line of Cleveland County to the middle of the right of way of the Atchison, Topeka & Santa Fe Railway; thence northerly following the middle of said right of way through Oklahoma, Logan, Noble, and Payne counties, and the Otoe, Missouri, and Ponca Indian reservations to the northern boundary of the Ponca Indian Reservation; thence east along the northern boundary of the Ponca Indian Reservation to the Arkansas River; thence in a northerly direction following the course of the said river to its intersection with the thirty-seventh parallel of north latitude at the southern boundary line of Kansas.

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the Territory of Oklahoma to enforce said quarantine line, therefore the above quarantine line is adopted for the Territory of Oklahoma by this Department for the period beginning with the date of this order and ending December 31, 1903, in lieu of the quarantine line described in the order of March 13, 1903, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle shall be moved or allowed to move from the counties of Greer, Roger Mills, Washita, Custer, Blaine (north of the Canadian River), Canadian, and that part of the counties of Oklahoma, Logan, Payne, and Noble, and of the Otoe, Missouri, and Ponca Indian reservations lying west of the right of way of the Atchison, Topeka & Santa Fe Railway, to any of that part of the Territory of Oklahoma lying west and north of said line, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the Territory of Oklahoma, and upon written permission by such officer, nor to any State or Territory outside of the quarantined district (except as provided for immediate slaughter), unless they have been duly inspected and passed, and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which destined.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 4 TO B. A. I. ORDER NO. 107.)

Special Order Modifying Quarantine Line for the State of Tennessee. (1903.)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

In accordance with the regulations to prevent the spread of splenetic fever of cattle, the State of Tennessee has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

Beginning on the Mississippi River at the southeast corner of the State of Missouri at the western boundary of Tennessee; thence southerly along the western boundaries of the counties of Dyer and

Lauderdale; thence following the main channel of the Mississippi River (leaving Island No. 37 to the north and west) to the northwestern corner of Shelby County on the Mississippi River; thence easterly along the northern boundary lines of Shelby and Fayette counties to the southwestern corner of Haywood County; thence northerly and easterly along the western and northern boundary lines of Haywood County to the northeastern corner of said county; thence easterly along the northern boundary line of Madison County to the southwest corner of Carroll County; thence northerly and easterly along the western and northern boundary lines of Carroll County to the northeast corner of said county; thence southerly along the eastern boundary of said county to its intersection with the N. C. & St. L. Railway; thence easterly along the middle of the roadbed of said railway through Benton County to the intersection of said N. C. & St. L. Railway with the Tennessee River at the eastern boundary of Benton County; thence south along the eastern boundaries of Benton and Decatur counties to the northwest corner of Wayne County; thence easterly along the northern boundary lines of Wayne and Lawrence counties to the northeastern corner of Lawrence County; thence south along the eastern boundary of Lawrence County to the southeast corner thereof; thence east along the southern boundary of Giles County to the Elk River; thence northeasterly along said river through Giles and Lincoln counties to the eastern boundary of Lincoln County; thence northerly and easterly along the western and northern boundaries of Moore County to the northeast corner of Moore County; thence north along the western boundary lines of Coffee and Cannon counties to the northwest corner of Cannon County; thence northeasterly and southeasterly along the northern and eastern boundaries of Cannon County to the boundary of Warren County; thence easterly along the northern boundary of Warren County to the western boundary of White County; thence northeasterly and southeasterly along the western and northern boundaries of White County to the western boundary of Cumberland County; thence southerly, easterly, and northeasterly along the western, southern, and eastern boundaries of Cumberland County to the northern corner of Rhea County; thence southerly along the eastern boundary lines of Rhea and James counties to the northwest corner of Bradley County; thence northerly and southeasterly along the northern boundary lines of Bradley and Polk counties to the northeast corner of Polk County; thence south along the eastern boundary line of Polk County to the southeast corner thereof at the southwestern corner of North Carolina.

That portion of the quarantine line for the State of Virginia, described in the order of March 14, 1903 (Amendment No. 7 to B. A. I. Order No. 107), beginning at the southwestern corner of Virginia (Lee County) and extending east along the southern boundary line of Virginia to the southeastern corner of Washington County, is hereby suspended during the enforcement of the above line for the State of Tennessee.

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of Tennessee to enforce said quarantine line, therefore the above line is adopted for the State of Tennessee by this Department for the period beginning with the date of this order and ending December 31, 1903, in lieu of the quarantine line described in the order of March 13, 1903, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line cattle now in the western and northern parts of Carroll County may be moved for purposes other than immediate slaughter to States and Territories outside of the quarantined area after being inspected and found free of infection by an inspector of this Department and upon written permission by such officer.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 5 TO B. A. I. ORDER NO. 107.)

Special Order Modifying Quarantine Line for the State of Georgia. (1903.)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

In accordance with the regulations to prevent the spread of splenetic fever of cattle, the State of Georgia has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

Beginning at the intersection of the western boundary line of Union County with the boundary line between the States of Georgia and North Carolina; thence southerly along the western boundary of Union County to the southwest corner thereof; thence northeasterly and easterly along the southern boundary lines of Union and Towns counties to the western corner of Rabun County; thence easterly, southeasterly, and northeasterly along the western, southern, and eastern boundaries of Rabun County to the northeast corner of said county on the boundary between Georgia and North Carolina.

That portion of the quarantine line for the State of North Carolina, described in the order of March 14, 1903 (Amendment No. 6 to B. A. I. Order No. 107), beginning at the intersection of the northwest corner of Union County, Ga., with the State line, extending east along the southern boundary line of North Carolina to the northeast corner of Rabun County, is hereby suspended during the enforcement of the above line for the State of Georgia.

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of Georgia to enforce said quarantine line, therefore the above quarantine line is adopted for the State of Georgia by this Department for the period beginning with the date of this order and ending December 31, 1903, in lieu of the quarantine line described in the order of March 13, 1903, for said area, unless otherwise ordered.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 6 TO B. A. I. ORDER NO. 107.)

Special Order Modifying Quarantine Line for the State of North Carolina. (1903.)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

In accordance with the regulations to prevent the spread of splenetic fever of cattle, the State of North Carolina has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

Beginning at the southwest corner of the county of Cherokee; thence east along the southern boundary lines of the counties of Cherokee, Clay, Macon, Jackson, Transylvania, and Henderson to the southwest corner of the county of Polk; thence northerly along the western boundaries of Polk and Rutherford counties to the southern boundary of McDowell County; thence westerly, northerly, and northeasterly along the southern, western, and northern boundaries of McDowell County to the western boundary of Burke County; thence southerly along the western boundary line of Burke County to the Catawba River; thence easterly along the course of said river to the southwestern corner of Alexander County; thence north along the western boundary of said county to the southern boundary of Wilkes County; thence northwesterly along the boundary line of Wilkes County to the western corner of said county; thence following the western and northern boundary line of Wilkes County to the western portion of Surry County; thence northeasterly along the western boundary line of Surry County to its intersection with the northern boundary line of the State of North Carolina.

That portion of the quarantine line for the State of Virginia, described in the order of March 14, 1903 (Amendment No. 7 to B. A. I. Order No. 107), beginning at the southwestern corner of Grayson County and extending east along the southern boundary line of Virginia to the southeastern corner of said county, is hereby suspended during the enforcement of the above line for the State of North Carolina.

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of North Carolina to enforce said quarantine line, therefore the above quarantine line is adopted for the State of North Carolina by this Department for the period beginning with the date of this order and ending December 31, 1903, in lieu of the quarantine line described in the order of March 13, 1903, for said area, unless otherwise ordered.

It is further ordered, That during the continuance of the above line no cattle originating in the quarantined district, as described in B. A. I. Order No. 107, as modified, shall be moved or allowed to move into the counties of Surry, Wilkes, McDowell, and that part of Burke south of the Catawba River.

And it is further ordered, That no cattle shall be moved or allowed to move from the counties of Surry, Wilkes, McDowell, and that part of Burke south of the Catawba River to any of that territory in the State of North Carolina lying west and north of said counties, except after having been inspected and found free of infection by duly authorized inspectors of this Department or of the State of North Carolina and upon written permission by such officer. No cattle from said counties shall be moved or allowed to move to any State or Territory outside of the quarantined district (except as provided for immediate slaughter), unless they have been duly inspected and passed, and permit issued by inspectors of this Department, nor until permission has been obtained from the proper officials of the State or Territory to which destined.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 7 TO B. A. I. ORDER NO. 107.)

Special Order Modifying Quarantine Line for the State of Virginia. (1903.)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

In accordance with the regulations to prevent the spread of splenetic fever of cattle, the State of Virginia has agreed to establish and to cooperate in the enforcement of a quarantine line located as follows:

Beginning at the boundary line of Virginia at its southwestern corner (Lee County); thence east along the the southern boundary of Virginia to the southwestern corner of Patrick County; thence northerly along the western boundaries of Patrick and Franklin counties to Daniels Run; thence easterly along Daniels Run and the Blackwater River to the Staunton River; thence in a southeasterly and northeasterly direction along the southern and eastern boundaries of Bedford County to the James River; thence following the James River to the southeastern corner of Charles City County; thence northerly and easterly along the western and northern boundaries of James City County to the western boundary of Gloucester County at the York River; thence southerly and northerly along the southern and eastern boundaries of Gloucester County to the northeastern corner of said county; thence easterly and southerly along the northern and eastern boundaries of Mathews County to the southeastern point of said county; thence south to the northern boundary of Elizabeth City County; thence westerly and northerly along the boundaries of Elizabeth City and Warwick counties to the

James River; thence southeasterly along the course of the said river to the northwest corner of Norfolk County; thence south along the western boundary of said county to its intersection with the northern boundary of North Carolina; thence east along the southern boundaries of Norfolk and Princess Anne counties to the Atlantic Ocean.

And whereas said quarantine line, as above set forth, is satisfactory to this Department, and legislation has been enacted by the State of Virginia to enforce said quarantine line, therefore the above quarantine line is adopted for the State of Virginia by this Department for the period beginning with the date of this order and ending December 31, 1903, in lieu of the quarantine line described in the order of March 13, 1903, for said area, unless otherwise ordered.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 8 TO B. A. I. ORDER NO. 107.)

Feeding Stations in the Quarantined District for Uninfected Cattle.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

It is hereby ordered, That cattle originating outside (north, east, and west) of the quarantined district, as defined in the order of March 13, 1903 (B. A. I. Order No. 107), and amendments thereto, and which are to be transported by rail through the quarantined district, may be unloaded for rest, feed, and water into uninfected pens set apart for such cattle at Polk Stock Yards and Union Stock Yards, Fort Worth, Texas; Baird, Texas; Southern Pacific Railway Stock Yards, Los Angeles, California; Bakersfield, California; and at Salisbury, North Carolina: *Provided,* That the cattle are free from southern cattle ticks and have not been unloaded at any other place within the quarantined district. They may, after unloading into said pens, be reloaded into the same cars from which unloaded, or into other cleaned and disinfected cars, and reshipped as uninfected cattle.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 9 TO B. A. I. ORDER NO. 107.)

Special Order Permitting Movement of Cattle from Two Northern Tiers of Counties in Arkansas.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

It is hereby ordered, That B. A. I. Order No. 107, dated March 13, 1903, be amended so as to permit the shipment of cattle for purposes other than immediate slaughter from the two northern tiers of counties in the State of Arkansas into the noninfected area: *Provided,* That said cattle have remained in the above-described counties since January 1 of this year and have been inspected by officers of the Bureau of Animal Industry of this Department and found to be free of splenetic, or Texas, fever and not to have been exposed to the contagion thereof; that proper facilities have been afforded for making such inspection; and that after inspection the cattle shall be shipped without delay and without exposure to the infection of splenetic, or Texas, fever: *Provided further,* That no cattle shall be allowed shipment under this order unless accompanied by a written permit issued by an inspector of the Bureau of Animal Industry, nor shall such cattle be taken into any State or Territory contrary to the local regulations, and said permission will be granted only for cattle which are to remain within the State to which destined for three months after arrival.

This order to remain in force until April 1, 1903.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 10 TO B. A. I. ORDER NO. 107.)

Special Order Permitting Movement of Cattle from Part of Ponca Indian Reservation.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

It is hereby ordered, That section 3 of B. A. I. Order No. 107, dated March 13, 1903, be amended so as to permit the shipment of cattle for other purposes than immediate slaughter to points in the noninfected area from that portion of the Ponca Indian Reservation, Oklahoma, east of the right of way of the Atchison, Topeka and Santa Fe Railway, and bounded on the east and north by the Arkansas River and the Salt Fork of the Arkansas River: *Provided,* That said cattle have been kept in the

above-described area since January 1, 1903, and have been inspected by an officer of the Bureau of Animal Industry of this Department and found free of splenetic, or Texas, fever and not to have been exposed to the contagion thereof: *And provided further*, That no cattle shall be allowed shipment from this area unless accompanied by a written permit issued by an officer of the Bureau of Animal Industry; and all such cattle shall be subject to the laws and regulations of the State to which destined. The cars in which such cattle are shipped must be free from infection and satisfactory to the officer supervising the shipment.

This order to terminate April 30, 1903.

JAMES WILSON, *Secretary*.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 14, 1903.

In consequence of the act of Congress approved February 2, 1903, entitled "An act to enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of live stock, and for other purposes," it was deemed advisable to revise and reissue the regulations relating to contagious diseases of animals so that they would have the additional power conferred by that act, and accordingly the regulations concerning the transportation of southern cattle are reissued. Advantage has been taken of the opportunity for revision to make a few slight additions to that part of the order of a general nature—one with reference to the separation of pens reserved for southern cattle from those used for other cattle, another referring to the disinfection of cars in the quarantined district. The special orders modifying the line for certain States are unchanged except as dates and references to orders are affected. The order modifying the line for the Territory of Oklahoma shows an alteration in its description, made to conform to the changes that have taken place through the formation of new counties and in the names of counties.

JAMES WILSON, *Secretary*.

(AMENDMENT NO. 11 TO B. A. I. ORDER NO. 107.)

Special Order Regarding Quarantine of Cattle in Certain Counties of Tennessee and Kentucky.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., May 5, 1903.

It is hereby ordered, That, as the infection of Texas fever exists in certain counties in the States of Tennessee and Kentucky, no cattle shall be moved or allowed to move, except as provided for southern cattle for immediate slaughter, to any portion of the uninfected area from the counties of Clinton, Wayne, and Pulaski of the State of Kentucky, and the counties of Pickett, Jackson, Overton, Fentress, Putnam, and Dekalb of the State of Tennessee, unless after inspection such cattle are found free of infection. This inspection must be made by duly authorized inspectors of the Bureau of Animal Industry of this Department, and movement allowed for other purposes than immediate slaughter only upon written permission by such inspectors.

The special order modifying the quarantine line for the State of Tennessee (Amendment No. 4 to B. A. I. Order No. 107) is hereby modified in accordance with the above provisions.

WILLIS L. MOORE, *Acting Secretary*.

(AMENDMENT NO. 12 TO B. A. I. ORDER NO. 107.)

Special Order Quarantining Part of Roane County, Tennessee.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., September 1, 1903.

It is hereby ordered, That, as the infection of splenetic fever of cattle has been found to exist in that part of Roane County, Tenn., lying north of the Tennessee and Clinch rivers, no cattle shall be moved or allowed to move, except as provided for southern cattle for immediate slaughter, to any portion of the uninfected area from said portion of Roane County unless, after inspection, such cattle are found free of infection. This inspection must be made by duly authorized inspectors of the Bureau of Animal Industry of this Department, and movement of cattle for purposes other than immediate slaughter may be made only upon written permission of such inspectors.

The special order modifying the quarantine line for the State of Tennessee (Amendment No. 4 to B. A. I. Order No. 107) is modified in accordance herewith.

JAMES WILSON, *Secretary*.

(AMENDMENT NO. 13 TO B. A. I. ORDER NO. 107.)

Feeding Station in the Indian Territory for Uninfected Cattle.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., September 24, 1903.

It is hereby ordered, That cattle originating outside (north, east, or west) of the quarantined district, as defined in the order of March 13, 1903 (B. A. I. Order No. 107), and amendments thereto, and which are to be transported by rail through the quarantined district, may be unloaded for rest, feed, and water into uninfected pens set apart for such cattle at the Sapulpa Stock Yards of the St. Louis & San Francisco Railroad, Sapulpa, Ind. T.: *Provided*, That the cattle are free from southern cattle ticks and have not been unloaded at any place within the quarantined district. They may, after unloading into said pens, be reloaded into the same cars from which unloaded, or into other cleaned and disinfected cars, and reshipped as uninfected cattle.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 14 TO B. A. I. ORDER NO. 107.)

Regulations to Prevent the Spread of Splenetic Fever of Cattle—Restrictions Modified.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., October 20, 1903.

It is hereby ordered, That section 3 of B. A. I. Order No. 107, dated March 13, 1903, providing for the movement of cattle from the quarantined district described by said order and amendments thereto, be amended as follows:

From November 1, 1903, to January 31, 1904, inclusive, cattle from said district may be moved for purposes other than immediate slaughter to the noninfected area within the States of Virginia, North Carolina, Tennessee, Texas, and California, and to the States of Missouri and Kansas and the Territories of Arizona and New Mexico, as may be provided for in the regulations of these States and Territories, and after inspection and upon written permission by an inspector of the Bureau of Animal Industry or a duly authorized inspector of the State or Territory to which the cattle are destined. From November 1 to December 31, 1903, inclusive, cattle from said district may be moved to the noninfected area in the Territory of Oklahoma after inspection and upon written permission by an inspector of the Bureau of Animal Industry. In the absence of such inspection and permission all movement of cattle from the quarantined district to points outside of such district in the above-named States and Territories is prohibited, except as provided for immediate slaughter.

All cattle from the quarantined district destined to points outside of the States and Territories above named may be shipped without inspection between November 1, 1903, and January 31, 1904, inclusive, and without restrictions other than may be enforced by local regulations at point of destination.

The reshipment to any part of the States of Virginia, North Carolina, Tennessee, Texas, and California and the Territory of Oklahoma, outside of the quarantined district, or to any part of the States of Missouri and Kansas and the Territories of New Mexico and Arizona, of any cattle which may have been moved under this order, except by permission of the proper authorities of the State or Territory to which destined, is hereby prohibited.

And it is further ordered, That all stock pens which may have been reserved for the use of cattle from the quarantined district, prior to November 1 next, shall not be used for receiving or storing cattle from the quarantined district which have been inspected and passed, nor for cattle originating outside of the quarantined district, except when such cattle are intended for immediate slaughter.

J. H. BRIGHAM, *Acting Secretary.*

(AMENDMENT NO. 15 TO B. A. I. ORDER NO. 107.)

Regulations to Prevent the Spread of Splenetic Fever of Cattle—Quarantine Line for the Territory of Oklahoma.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 29, 1903.

It is hereby ordered, That section 3 of B. A. I. Order No. 107, dated March 13, 1903, providing for the movement of cattle from the quarantined district prescribed by said order and amendments thereto, be amended as follows:

Beginning January 1, 1904, the quarantine line described and established by amendment No. 3, dated March 14, 19C3, to B. A. I. Order No. 107, shall continue in effect for the Territory of Oklahoma until otherwise ordered.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 108.)

Regulations to Prevent the Spread of Sheep Scab.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 3, 1903.

To managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In furtherance of the regulations for the suppression and extirpation of contagious and infectious diseases among domestic animals in the United States, dated March 10, 1903 (B. A. I. Order No. 106), notice is hereby given that a contagious disease known as scabies, or sheep scab, exists among sheep in the United States, and in order to prevent the dissemination of said disease and to aid in its eradication, the following regulations are established and observance thereof required:

1. It is required of everyone intending to ship or to trail sheep to ascertain that the sheep are not affected with scabies and have not been exposed to the contagion thereof before offering them for transportation or before crossing State or Territorial boundaries. Transportation companies are required to provide cleaned and disinfected cars or other vehicles for the reception of sheep, and to refuse for shipment sheep whose freedom from disease and from exposure to contagion is in doubt. Sheep that are not affected with scabies and that have not been exposed to the contagion may be shipped or trailed without restriction, unless they are in a locality where inspection and certification are required before their removal therefrom.

2. Sheep that are affected with scabies or that have been exposed to the contagion of scabies, either through contact with infected flocks or infected premises, pens, or cars, shall not be shipped or driven from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia, or into public stock yards or feeding stations, until they have been dipped in a mixture approved by this Department, except as provided in rule 4.

3. Sheep that are affected with the disease may be shipped for immediate slaughter after one dipping, but if they are intended for feeding or stocking purposes they shall be held for a second dipping ten days after the first one. All of the sheep in a certain flock or shipment in which the disease is present shall be considered as affected with the disease.

4. Sheep that are not affected with the disease, but which have been exposed to the contagion, may be shipped for feeding or stocking purposes after one dipping, but may be shipped for immediate slaughter without dipping.

5. When affected sheep are shipped for slaughter after one dipping, and when exposed sheep are shipped for slaughter without dipping, the cars conveying them shall be marked on each side with a card bearing the words "Scabby Sheep," and said cards shall not be removed until the cars have been cleaned and disinfected.

6. The dips now approved are:

(*a*) The tobacco and sulphur dip, made with sufficient extract of tobacco or nicotine solution to give a mixture containing not less than five one-hundredths of 1 per cent of nicotine and 2 per cent flowers of sulphur.

(*b*) The lime and sulphur dip, made with eight pounds of unslaked lime and twenty-four pounds of flowers of sulphur to one hundred gallons of water. The lime and sulphur should be boiled together for not less than two hours, and all sediment allowed to subside before the liquid is placed in the dipping vat.

Either one of these dips may be used.

7. The dipping must be done carefully and the sheep handled as humanely as possible. The Department, however, assumes no responsibility for loss or damage resulting from the dipping, and those who wish to avoid any risks that may be incident to dipping at the stock yards, as well as to avoid liability to prosecution, should see that their sheep are free from disease before shipping them to market.

8. The sheep must be kept in the dip between two and three minutes and their heads be submerged at least once, though for but an instant at a time, and assistance must be rendered immediately if they appear to be strangling. The dip must be maintained at a temperature between 100° F. and 105° F. while the sheep are in it. It must be changed as soon as it becomes filthy, regardless of the number of sheep dipped in it, and in no case shall it be used when more than one week old. In emptying the dipping vat the entire contents must be removed, including all sediment and droppings or other foreign matter.

9. Suitable dripping platforms and drying pens shall be provided. In cold weather sheep shall not be dipped unless they can be kept in a warm pen until dry. Sheep shall not be loaded until they have become dry.

10. Where large numbers of sheep in a district are ready for transportation, inspectors of the Bureau of Animal Industry will make inspections and give certificates for sheep found free from disease and not to have been exposed to the contagion and for sheep dipped under their supervision. Certificates will also be given at feeding stations and stock yards where inspectors may be stationed.

11. Sheep shipped under a certificate are not guaranteed uninterrupted transit; for in the event of the development of scabies or exposure to it en route they shall be dipped before proceeding to their destination, and the cars or other vehicles, and the chutes, alleys, and pens that may have been occupied shall be cleaned and disinfected.

12. Public stock yards shall be considered as infected and the sheep yarded therein as having been exposed to the disease, and no sheep may be shipped out without being dipped, with the exception noted in rule 4. Where, however, a part of the stock yards is set apart for the reception of uninfected shipments of sheep and is kept free of disease, sheep may be shipped from such part without dipping. If by chance affected sheep are introduced into such reserved part, they shall be immediately removed therefrom and the chutes, alleys, and pens used by them thoroughly cleaned and disinfected. No sheep may be shipped for feeding or stocking from any stock yards where an inspector of the Bureau of Animal Industry is stationed without a certificate of inspection or of dipping given by him.

13. Cars and other vehicles, yards, pens, sheds, chutes, etc., that have contained affected or exposed sheep shall be cleaned and disinfected immediately after the sheep are removed therefrom.

14. Cleaning and disinfection shall be done by first removing all litter and manure and then saturating the interior surfaces of the cars and the woodwork, flooring, and ground of the chutes, alleys, and pens with a 5 per cent solution of crude carbolic acid in water, with sufficient lime to show where it has been applied.

15. Violation of this order is punishable by a fine of not less than one hundred dollars nor more than one thousand dollars, or by imprisonment not exceeding one year, or by both fine and imprisonment.

16. B. A. I. Orders No. 5 and No. 38 are hereby revoked.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 109.)

Regulations for the Inspection and Quarantine of Horses, Neat Cattle, Sheep, and other Ruminants, and Swine Imported into the United States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 10, 1903.

In pursuance with sections 7, 8, and 10 of the act of Congress entitled "An act providing for the inspection of meats for exportation, and prohibiting the importation of adulterated articles of food or drink, and authorizing the President to make proclamation in certain cases, and for other purposes," approved August 30, 1890, and of the act of Congress approved February 2, 1903, entitled "An act to enable the Secretary of Agriculture to more effectually suppress and prevent the spread of contagious and infectious diseases of live stock, and for other purposes," the following regulations are hereby prescribed for the inspection and quarantine of horses, neat cattle, sheep, and other ruminants, and swine imported into the United States on and after May 1, 1903:

1. With the approval of the Secretary of the Treasury the following-named ports, subports, and customs stations are hereby designated as quarantine stations, and all horses, cattle, sheep, and other ruminants, and swine imported into the United States and which are subject to quarantine and inspection must be entered through said stations, viz:

On the Atlantic seaboard: Boston, Mass.; New York, N. Y., and Baltimore, Md. On the Pacific seaboard: San Francisco, San Diego, Cal., and Port Townsend, Wash. Along the boundary line between the United States and Mexico: Nogales, Ariz.; El Paso, Eagle Pass, Laredo, and Brownsville, Tex. Along the border or boundary line between the United States and Canada: Vanceboro, Houlton, Van Buren, and Fort Fairfield, Me.; Beecher Falls, Island Pond, Newport, Richford, and St. Albans, Vt.; Rouse Point, Hogansburg, Massena, Ogdensburg, Cape Vincent, Clayton, Charlotte, Niagara Falls, and Buffalo, N. Y.; Detroit, Port Huron, and Sault Ste. Marie, Mich., and Pembina, N. Dak.

The following-named stations are designated for the entry of animals which are subject to inspection only, viz: Eastport and Calais, Me.; Derby Line, North Troy, Alburg, and Swanton, Vt.; Mooers Junction, Chateaugay, Fort Covington, Malone, Waddington, Morristown, Lisbon, and Alexandria Bay, N. Y.; Blaine, Sumas, and Seattle, Wash.

2. The word "animals," when used in these regulations, refers to and includes all or any of the following kinds: Horses, asses, and mules; neat cattle, sheep, and other ruminants, and swine.

Under the word "horses" will be included asses and mules, and under the word "sheep" will be included all ruminants except cattle. The words "contagious diseases," when used in these regulations, includes and applies to all or any of the following diseases: Glanders and farcy, maladie du coït, distemper, or strangles, anthrax, contagious pleuro-pneumonia, Texas (or splenetic) fever, tubercu-

losis, actinomycosis, foot-and-mouth disease, rinderpest, variola, foot rot, scabies, hog cholera, swine plague, and erysipelas.

(*a*) All horses imported into the United States from any part of the world, except as otherwise provided for the countries of North America, shall be required to pass a veterinary inspection at the port of entry by an inspector of the Bureau of Animal Industry. Such inspector shall not allow the landing of any hay, straw, or forage which accompany shipments of horses originating in any country on the continent of Europe. In case the inspector finds horses to be affected with any contagious disease, he shall isolate them and immediately report to the Chief of the Bureau of Animal Industry, who may refuse the landing of horses affected with such diseases.

(*b*) All cattle, sheep, and other ruminants imported into the United States from any part of the world, except as hereinafter provided for the countries of North America, shall be accompanied with a certificate from the local authority of the district in which said animals have been for one year next preceding the date of shipment, stating that no contagious pleuro-pneumonia, foot-and-mouth disease, anthrax, rinderpest, or any other disease contagious to cattle has existed in said district for the past year.

(*c*) All swine imported into the United States from any part of the world, except as otherwise provided for the countries of North America, shall be accompanied with a certificate similar to the one required for cattle, sheep, and other ruminants, relating to the existence of foot-and-mouth disease, hog cholera, swine plague, and erysipelas.

(*d*) All such animals shall also be accompanied with an affidavit by the owner, stating that said animals have been in the district where purchased for one year next preceding the date of sale, and that no contagious disease affecting the species of animals imported has existed among them, nor among any animals of the kind with which they have come in contact, for one year last past, and that no inoculation has been practiced among said animals for the past two years; also by an affidavit from the importer or his agent supervising the shipment, stating that they have not passed through any district infected with contagious diseases affecting said kind of animals; that they have not been exposed in any possible manner to the contagion of any of said contagious diseases, and that the animals, when not driven, have been shipped in clean and disinfected cars and vessels direct from the farm where purchased.

(*e*) The foregoing certificate and affidavits must accompany said animals and be presented to the collector of customs at the port of entry, and by him be delivered to the inspector of the Bureau of Animal Industry stationed at said port, to allow them to be imported into the United States.

4. All neat cattle imported into the United States from any part of the world, except as provided for the countries of North and Central America, Great Britain, Ireland, and the Channel Islands, shall be subject to a quarantine of ninety days counting from the date of shipment; this date of shipment to be the date of clearance of the vessel bringing the animals to the United States. Sheep and other ruminants and swine from any part of the world, except North and Central America, shall be subject to a quarantine of fifteen days counting from the date of arrival at the quarantine station: *Provided*, That cattle and sheep imported for slaughter at the port of landing may be imported without quarantine, but shall be subject to such restrictions as the Chief of the Bureau of Animal Industry, after causing an inspection to be made, may consider necessary in each case for guarding the domestic animals of the United States from contagion: *Provided further*, That the period of quarantine for cattle imported from Great Britain, Ireland, and the Channel Islands shall be sixty days counting from the date of shipment.

5. All cattle over six months old imported from Great Britain directly into the United States, which are subject to quarantine, and except as otherwise provided, shall be tested with tuberculin by an inspector of this Department, stationed in that country, or after arrival at the animal quarantine station at the port of entry. Cattle from countries not otherwise provided for shall be tested in the said quarantine station. All cattle so tested which show a reaction shall be prohibited from entry into the United States or be disposed of as provided in section 10 of these regulations. Cattle imported into the United States directly from the islands of Jersey and Guernsey may be admitted without being tested with tuberculin.

Those desiring animals tested abroad should address Dr. Toole A. Geddes, care of U. S. consul-general's office, London, England.

IMPORTATIONS FROM CANADA INTO THE UNITED STATES.

6. All animals imported into the United States from the Dominion of Canada must be accompanied by an affidavit made by the owner or importer, declaring clearly the purpose for which said animals are imported, viz, whether for breeding purposes, for milk production, for work, for grazing, feeding, or slaughter, or whether they form part of settlers' effects, or whether they are horses entered for temporary stay, as provided by these regulations. Said affidavit must be presented to the collector of customs at the port of entry, who will decide whether the animals are entitled to enter under these regulations, and who will notify the inspector of the Bureau of Animal Industry in all cases where the regulations require an inspection to be made.

(*a*) Horses for breeding, racing, show, and sale purposes, for grazing or for work, must be inspected at the port of entry. Those belonging to Indian tribes and settlers, and those used in connection with stock raising (cow ponies), or mining, and those for temporary stay at points along the frontier,

not exceeding two weeks, whether for pleasure, driving, or teaming, are not required to be inspected Horses will be admitted in bond at any port of the United States without inspection for export from any port of the United States; they shall, however, be subject to inspection when exported from ports at which this Department has inspectors stationed.

(*b*) Cattle for breeding purposes, milk production, grazing, or feeding must be inspected, and must be accompanied by a certificate signed by a Canadian official veterinarian stating that no contagious disease affecting cattle, except tuberculosis and actinomycosis, has existed in the district in which the animals have been kept for six months preceding the date of importation. The owner must present an affidavit that said certificate refers to the cattle in question.

(*c*) A certificate for cattle over 6 months old for breeding purposes and for milch cows must also show that they have been submitted to the tuberculin test by a Canadian official veterinarian or an inspector of the Bureau of Animal Industry, and found free from tuberculosis, giving the date and place of testing, with the chart of reaction, and a description of the cattle, with age and markings.

(*d*) All cattle imported for breeding, milk production, grazing, or feeding, when not accompanied by the required affidavits and certificates, must be detained in quarantine for one week, at the expense of the owner or importer, under the supervision of the inspector in charge. During this detention a rigid inspection will be made, and cattle over 6 months old for breeding and milk production will be tested with tuberculin. Animals found free from disease at the end of that period will be released.

(*e*) Cattle for slaughter shall be inspected.

(*f*) Those forming part of settlers' effects or belonging to Indian tribes will be admitted through any port without inspection or certification.

(*g*) Any animals may be required to be inspected at the port of entry, and any cattle showing symptoms of tuberculosis may be subjected to the tuberculin test, upon instructions from the Chief of the Bureau of Animal Industry.

(*h*) Cattle in bond for export will be admitted without inspection at any of the ports named in section 1 in transit to, and for export from, Portland, Me.; Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Newport News and Norfolk, Va.

(*i*) All sheep imported into the United States for breeding, grazing, or feeding must be inspected, and must be accompanied by a certificate signed by a Canadian official veterinarian, stating that no contagious disease affecting sheep has existed in the district in which the animals have been kept for six months preceding the date of importation. The owner or importer must present an affidavit that said certificate refers to the sheep in question.

(*j*) Sheep for breeding purposes, grazing, or feeding, when not accompanied by the required affidavits and certificates, must be detained in quarantine for one week at the expense of the owner or importer, under the supervision of the inspector in charge. During this detention a rigid inspection will be made. Sheep found free from disease at the end of this period will be released.

(*k*) Sheep for grazing or feeding, if accompanied by the required affidavits and certificates, need not be unloaded for inspection.

(*l*) Sheep for immediate slaughter, and those belonging to Indian tribes or forming part of settlers' effects, will be admitted through any port without inspection or certification.

(*m*) Sheep in bond for export will be admitted without inspection at any of the ports mentioned in section 1 in transit to, and for export from, Portland, Me.; Boston, Mass.; New York, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Newport News and Norfolk, Va.

(*n*) All swine shall be subjected to inspection, except those belonging to Indian tribes or forming part of settlers' effects, which will be admitted at any port without inspection. Swine imported for breeding purposes, grazing, or feeding shall be accompanied by an official veterinary certificate, as indicated for cattle and horses. The owner or importer must present an affidavit that said certificate refers to the swine in question. Swine not accompanied by affidavits and certificates will be subject to the same quarantine as provided for sheep.

(*o*) The railroad cars used in the transportation of animals specified by these regulations must be thoroughly cleaned and disinfected before said animals are placed therein. All litter from previous shipments must be removed, and the car whitewashed with lime and carbolic acid, 1 pound of 100 per cent straw-colored commercial carbolic acid to 5 gallons of lime wash. Unless this regulation is complied with, Canadian animals will not be allowed entry into the United States, and animals from the United States will not be admitted into Canada. Shippers should see that cars are properly cleaned and disinfected before animals are loaded.

IMPORTATIONS FROM MEXICO INTO THE UNITED STATES.

7. (*a*) Horses for breeding, racing, show, and sale purposes, for grazing, or for work must be inspected at the port of entry. Those belonging to Indian tribes and settlers, and those used in connection with stock raising (cow ponies) or mining, and those for temporary stay at points along the frontier, not exceeding two weeks, whether for pleasure, driving, or teaming are not required to be inspected. Horses will be admitted in bond at any port of the United States without inspection for export from any port of the United States. They shall, however, be subjected to inspection when exported from ports at which this Department has inspectors stationed.

(*b*) All cattle imported into the United States from Mexico are subject to inspection. Cattle for

breeding purposes, milk production, grazing, or feeding must be accompanied by an affidavit, made by the owner, stating that said cattle have been in the district from which shipped for six months next preceding the date of importation and that no contagious disease affecting cattle has existed among them nor among any animals of the kind with which they have come in contact for six months last past; also by an affidavit, made by the importer or his agent supervising the shipment, stating that they have not passed through any district infected with contagious diseases affecting cattle, that they have not been exposed in any possible manner to the contagion of any contagious disease, and that the animals, when not driven, have been shipped in cleaned and disinfected cars and vessels direct from the farm or ranch where purchased.

(*c*) All cattle imported for breeding purposes, milk production, grazing, or feeding, when not accompanied by the required affidavits must be detained in quarantine for one week at the expense of the owner or importer, under the supervision of the inspector in charge. During this detention a rigid inspection will be made,

(*d*) Cattle for immediate slaughter may be admitted, when found free from disease, upon inspection only, and when so entered said cattle shall be subject to the regulations pertaining to the transportation of cattle from the district infected with Texas, or splenetic, fever.

(*e*) Sheep for breeding purposes, grazing, or feeding must be accompanied by an affidavit made by the owner of said sheep stating that they have been in the district from which shipped for six months next preceding the date of importation, and that no contagious disease affecting sheep has existed among them nor among other animals of the kind with which they have come in contact for six months last past; also, by an affidavit, made by the importer or his agent supervising the shipment, stating that they have not passed through any district infected with contagious diseases affecting sheep; that they have not been exposed in any possible manner to the contagion of any contagious disease, and that the animals, if not driven, have been shipped in cleaned and disinfected cars and vessels direct from the farm or ranch where purchased. Sheep for breeding purposes, grazing, or feeding, not accompanied by the required affidavits, must be detained in quarantine for one week, at the expense of the owner or importer, under the supervision of the inspector in charge.

(*f*) All swine shall be accompanied with affidavits similar to those required for cattle and sheep, relating to the existence of contagious disease affecting swine, and when not accompanied by said affidavits shall be detained in quarantine for one week, as provided for cattle and sheep.

8. Animals admitted from North American countries for immediate slaughter must be consigned to some recognized slaughtering center and must be slaughtered within two weeks from date of entry. All animals admitted for export will be subject to inspection at the port of export.

IMPORTATIONS IN GENERAL.

9. Any person contemplating the importation of animals other than horses from any part of the world, except the countries of North and Central America, must first obtain from the Secretary of Agriculture two permits, one stating the number of and kind of animals to be imported, the port, and probable date of shipment, which will entitle them to clearance papers on presentation to the American consul at said port of shipment; the other stating the port at which said animals are to be landed and quarantined and the approximate date of their arrival, and this will assure the reception of the number and kind specified therein at the port and quarantine station named at the date prescribed for their arrival or at any time during three weeks immediately following, after which the permit will be void. These permits shall in no case be available at any port other than the one mentioned therein. Permits must be in the name of the owner of, or agent for, any one lot of animals. A quarantine release will be given each owner for the number and kind of animals belonging to him which are discharged from quarantine, and this release will be a certificate of fulfillment of quarantine regulations. In case an importation of animals is owned by more than one person, a release will be issued to each owner covering the animals which belong to him. Permits will be issued to quarantine at such ports as the importer may elect, so far as facilities exist at such port, but in no case will permits for importation at any port be granted in excess of the accommodations of the Government quarantine station at such port. United States consuls should give clearance papers or certificates for animals from their districts intended for exportation to the United States only upon presentation of permits as above provided, with dates of probable arrival and destination corresponding with said permits, and in no case for a number in excess of that mentioned therein. When such shipments originate in the interior of a foreign country, these permits should be submitted to the consul of that district and, through the forwarding agent, to the consul at the port of embarkation.

10. All animals imported into the United States, and which are subject to inspection, shall be carefully inspected by an inspector of the Bureau of Animal Industry, and all animals found to be free from disease and not to have been exposed to any contagious disease shall be admitted into the United States, subject to the provisions for quarantine as established in section 4, except as otherwise provided. Whenever any animal, upon arrival at the port of entry or in the quarantine station, is found to be affected with a contagious disease or to have been exposed to such disease said animal, and all animals that have been in contact with or exposed to said animal, shall be placed in special quarantine. All animals so quarantined, either on arrival at port of entry or after reaching the quarantine station, shall be at once reported by the inspector to the Chief of the Bureau of Animal Indus-

try, who will direct whether or not said animals quarantined shall be appraised and slaughtered, as provided by section 8 of the act approved August 30, 1890.

11. In case of imported animals proving to be infected or to have been exposed to infection, such portions of the cargo or the vessel on which they have arrived as have been exposed to these animals or their emanations shall be subjected, under the direction of the inspector of the Bureau of Animal Industry, to disinfection in such manner as may be considered by said inspector necessary before it can be landed. In all cases the parts of the vessel that have been occupied by imported animals shall be cleaned and disinfected with limewash under the supervision of the inspector of the port.

12. No litter, fodder, or other aliment, nor any ropes, straps, chains, girths, blankets, poles, buckets, or other things used for or about the animals, and no manure, shall be landed from any vessel excepting under such regulations as the inspector shall provide.

13. On moving animals from the ocean steamer to the quarantine grounds they shall not be unecessarily passed over any highways, but must be placed on cars at the wharves or removed to the cars on a boat which is not used for conveying other animals. If such boat has carried animals within three months it must be first cleaned and then disinfected under the supervision of the inspector, and after the conveyance of the imported animals the boat must be disinfected in the same manner before it may be again used for the conveyance of animals. When passage upon or across the public highway is unavoidable in the transportation of animals from the place of landing to the quarantine grounds, it must be under such careful supervision and restrictions as the inspector may in special cases direct.

14. The platforms and chutes used for loading and unloading imported animals shall be reserved for such cattle, or shall be cleansed and disinfected as above before being used for such imported cattle.

15. The railway cars used in the transportation of animals to the quarantine grounds shall be either cars reserved for this exclusive use or box cars not otherwise employed in the transportation of animals or their fresh products, and after each journey with animals to the quarantine grounds they shall be disinfected by thorough cleansing and disinfection under the direction of the inspector.

16. While animals are arriving at the quarantine stations or leaving them, all quarantined stock in the yards adjoining the alleyways through which they must pass shall be rigidly confined to their sheds. Animals arriving by the same ship may be quarantined together in one yard and shed, but those coming on different ships shall in all cases be placed in separate yards.

17. The gates of the quarantine stations and of all yards of said stations shall be kept locked, except when animals are entering or leaving quarantine.

18. The attendants on animals in particular yards are forbidden to enter other yards and buildings, unless such are occupied by stock of the same shipment with those under their special care. No dogs, cats, or other animals, except those necessarily present, shall be allowed in the quarantine grounds.

19. The allotment of yards shall be under the direction of the inspector in charge, who shall keep a register of animals entered, with description, name of owner, name of vessel in which imported, date of arrival and release, and other important particulars.

20. The inspector shall see that water is regularly furnished to the stock. Special places for depositing manure from yards and stables shall be provided, and no manure shall be removed from the quarantine station until the release of the animals from which produced.

21. Milk from quarantined animals shall not be used by any persons other than those in charge of such animals nor fed to any other animals than those within the same lot until ten days after the date of quarantine.

22. Food and attendants must be provided by the owners of the stock quarantined, and said owner or his agent shall give satisfactory assurance to the inspector at the time of admission to quarantine that such provision will be made. The employees of such owners shall keep the sheds and yards clean to the satisfaction of the inspector and be subject to the rules of the station. If for any cause the owners of the quarantined stock refuse or neglect to supply food and attendants, the inspector will furnish the same. The food and care so furnished shall be at the expense of the owners of the stock, and the charges therefor will be a lien on the animals. After the expiration of one-third of the quarantine period, if payment has not been made, the owners of the animals will be notified by the inspector that if said charges be not immediately paid or satisfactory arrangements made for the payment, the inspector will sell the stock at public auction at the expiration of the period of quarantine, to pay the expense of food and care during that period, Notice of the sale will be published once a week for two weeks in a newspaper published in the county where the station is located; the day of sale will be at the expiration of the quarantine period and at such place as may be designated by the inspector. From the proceeds of the sale an amount equal to the charges for food and care of the animals and the expenses of the sale will be covered into the United States Treasury, and the remainder, if any, will be held for the owners; but if not called for at the end of six months from the date of sale, this balance will be deposited in the United States Treasury.

23. Smoking is strictly forbidden within any quarantine inclosure.

24. No visitor shall be admitted to the quarantine station without special written permission from the inspector. Butchers, cattle dealers, and their employees are especially excluded.

25. No public sale shall be allowed within the quarantine grounds.

26. The inspector shall, in his daily rounds, so far as possible, take the temperature of each animal,

commencing with the herds that have been longest in quarantine and ending with the most recent arrivals, and shall record such temperatures on lists kept for the purpose. In passing from one herd to another he shall invariably wash his thermometer and hands in a weak solution (1 to 40) of carbolic acid.

27. In case of the appearance of any disease that is diagnosed to be of a contagious nature, the inspector shall notify the Chief of the Bureau of Animal Industry, who shall visit the station personally or send an inspector, and on the confirmation of the diagnosis the herd shall be disposed of according to the gravity of the affection.

28. The yard and shed in which such disease shall have appeared shall be subjected to a thorough disinfection. Litter and fodder shall be burned. Yards, fences, sheds, utensils, and other appliances shall be disinfected as the Chief of the Bureau of Animal Industry may direct.

29. In case of the appearance of any contagious disease, the infected herd shall be rigidly confined to its sheds, where disinfectants shall be freely used, and the attendants shall be forbidden all intercourse with the attendants in other yards and with persons outside the quarantine grounds.

30. The inspector in charge shall see that the above rules and regulations are complied with.

31. This order supersedes B. A. I. Order No. 56, with its amendments, including B. A. I. Orders Nos. 58, 64, 77, and 79.

JAMES WILSON, *Secretary.*

(AMENDMENT NO. 1 TO B. A. I. ORDER NO. 109.)

Regulations for the Inspection and Quarantine of Horses, Neat Cattle, Sheep, and Other Ruminants, and Swine Imported Into the United States.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., September 29, 1903.

It is hereby ordered, That rule 1 of the regulations for the inspection and quarantine of animals imported into the United States issued under date of April 10, 1903 (B. A. I. Order No. 109), be, and is hereby, amended by the addition of Lowelltown, Me. (port of Bangor, Me.), as an animal quarantine station during the months of October and November, 1903, for the inspection and quarantine of animals imported into the United States. This order to terminate November 30, 1903.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 110.)

Quarantine of Cattle, Sheep, and Other Ruminants, and Swine in the State of Massachusetts.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 15, 1903.

To managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In furtherance of the regulations for the suppression and extirpation of contagious and infectiou, diseases among domestic animals in the United States, dated March 10, 1903 (B. A. I. Order No. 106), notice is hereby given that a contagious and infectious disease known as foot-and-mouth disease exists among animals in the State of Massachusetts, and that the cattle, sheep, and other ruminants, and swine in said State have been exposed to the contagion of said disease. In order to prevent the spread of said disease from Massachusetts into other States or foreign countries, and to aid in its eradication, the following regulations are established and observance thereof required:

1. No cattle, sheep, or other ruminants, or swine shall be moved or be permitted to move from said State.

2. Said animals shall not be moved or shipped across said State except for immediate slaughter, and when so shipped they shall be transported in cars sealed by inspectors of the Bureau of Animal Industry; they shall not be unloaded while within said State; the seals on the cars shall not be broken except at their destination, and the transportation of the animals shall be so arranged that the time of their confinement in the cars shall not exceed the limit fixed by law.

3. Said animals may be shipped into Massachusetts from States not in quarantine on account of foot-and-mouth disease without restriction, except when transported across another quarantined State, in which case they may be shipped only for immediate slaughter and in accordance with the requirements stated in rule 2.

4. All cars which have carried animals into or within the limits of said State shall be cleaned and disinfected before leaving said State: *Provided*, That where there are no facilities for disinfection, or

when the condition of the weather prevents its proper accomplishment, such cars may be allowed to go out without disinfection if they are sealed at the time of unloading by an inspector of the Bureau of Animal Industry and said seal is not broken until after arrival in uninfected territory.

5. The cleaning and disinfection shall be done in the following manner: First clean the car thoroughly; then the entire interior surface of the car is to be thoroughly washed with a mixture of 1½ pounds of lime and 7 ounces of 100 per cent carbolic acid to each gallon of water or of the same quantity of lime with 7 ounces of chloride of lime to each gallon of water. If the work is supervised by an inspector of this Department, instead of using the foregoing mixtures the disinfection may be done with a jet of steam under a pressure of not less than 50 pounds to the square inch. The litter and manure taken from cars that have carried animals within the limits of said State shall be disinfected by mixing it with lime or saturating it with a 5 per cent solution of 100 per cent carbolic acid.

6. The hides, skins, hair, wool, horns, or hoofs of ruminants or swine shall not be removed from said State, except in cases where the Chief of the Bureau of Animal Industry determines that it may be done with safety and in accordance with his directions.

7. Violation of this order is punishable by a fine of not less than $100 nor more than $1,000, or by imprisonment not exceeding one year, or by both fine and imprisonment.

8. This order supersedes the provisions of B. A. I. Order No. 99 and amendments thereto, in so far as the movement of animals and animal products from or across Massachusetts is concerned.

J. H. BRIGHAM, *Acting Secretary.*

(B. A. I. ORDER NO. 111.)

Regulations to Prevent the Spread of Hog Cholera and Swine Plague.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., April 29, 1903.

To managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In furtherance of the regulations for the suppression and extirpation of contagious and infectious diseases among domestic animals in the United States, dated March 10, 1903 (B. A. I. Order No. 106), notice is hereby given that the infectious diseases known as cholera and swine plague exist among swine in the United States, and in order to prevent the dissemination of said diseases the following regulations concerning the transportation of swine must be observed:

1. Swine that are not affected with either of said diseases and that have not been in contact with animals so diseased, and have not been in cars, pens, or other premises where they may have been exposed to the contagion of the disease, may be shipped without restriction other than may be imposed by the authorities of the State or Territory to which destined.

2. No swine so affected or exposed shall be offered for transportation or transported out of any State, Territory, or the District of Columbia, or from or into public stock yards, except as herein provided. It is required of all persons intending to ship swine to ascertain that the animals are not affected with and have not been exposed to the contagion of either of said diseases before offering them for shipment.

3. Public stock yards shall be considered as infected, and no swine shall be shipped therefrom for feeding or stocking purposes. No affected swine shall be allowed to be shipped out of the stock yards, but shall be slaughtered subject to condemnation on postmortem inspection; and all animals in a certain lot or shipment shall be considered as affected when one or more of them show evidence of the disease. Swine that are not affected and have been merely exposed by being in the yards may be shipped for immediate slaughter. Where, however, a part of the yards is set apart for the reception of uninfected shipments of swine and is kept free of infection, swine may be shipped from such part without restriction. Should such part be contaminated by the introduction of affected animals said animals shall be immediately removed therefrom, and the chutes, alleys, and pens used by them thoroughly cleaned and disinfected.

4. Cars and other vehicles that have contained affected or exposed swine shall be cleaned and disinfected as soon as possible after unloading. Cars shall not be removed before the inspector has had time to ascertain the condition of the animals and to give notice that the cars must be cleaned and disinfected.

5. Cleaning and disinfection shall be done by first removing all litter and manure and then saturating the interior surfaces of the cars and the woodwork, flooring, and ground of the chutes, alleys, and pens with a 5 per cent solution of crude carbolic acid in water, with sufficient lime to show where it has been applied.

6. Violation of this order is punishable by a fine of not less than one hundred dollars nor more than one thousand dollars, or by imprisonment not exceeding one year, or by both fine and imprisonment.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 112.)

Modification of Quarantine upon Ruminants and Swine in the State of Vermont.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., May 1, 1903.

It is hereby ordered, That the quarantine upon cattle, sheep, and other ruminants, and swine in the State of Vermont, imposed on account of foot-and-mouth disease, be modified, and that said animals and their products may be shipped or otherwise removed from said State without restrictions other than may be imposed by the authorities of the States to which said animals or products are destined: *Provided, however,* That until further orders said animals shall not be removed or be allowed to move from the townships of Ludlow, Cavendish, Weathersfield, Weston, Andover, Chester, and Springfield, in the county of Windsor, and the townships of Londonderry, Windham, Grafton, Rockingham, Jamaica, Townshend, and Athens, in the county of Windham, except after inspection by an inspector of the Bureau of Animal Industry and only when accompanied by a written permit issued by him.

This order supersedes the provisions of B. A. I. Order No. 99 and amendments thereto, in so far as the movement of animals and animal products from or across Vermont is concerned.

The act of Congress approved February 2, 1903, conferring authority upon the Secretary of Agriculture to make regulations for the suppression of contagious diseases of animals, provides for their violation a penalty of a fine of not less than one hundred dollars nor more than one thousand dollars, or imprisonment not exceeding one year, or both.

JAMES WILSON, *Secretary.*

Dr. Marion Imes, an inspector of the Bureau of Animal Industry, is stationed at Chester, Vermont, and application should be made to him for the inspection of animals and for permits to move them from the townships mentioned.

(B. A. I. ORDER NO. 113.)

Quarantine of Cattle, Sheep, and other Ruminants, and Swine in New Hampshire and Massachusetts.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., May 12, 1903.

It is hereby ordered, That live stock may be shipped from Vermont into Massachusetts across New Hampshire, subject to the regulations of the State of Massachusetts, for purposes other than immediate slaughter, when shipped in cars sealed by inspectors of the Bureau of Animal Industry and the seals are not broken except after arrival at their destination.

It is further ordered, That live stock may be shipped from New Hampshire into Massachusetts, subject to the regulations of the latter State, for immediate slaughter at Boston (including Brighton and Cambridge) and Somerville: *Provided,* That they shall not be unloaded en route nor at any public stock yard, nor be driven over any streets, but shall be taken by rail to an abattoir where inspection is maintained by this Department.

It is also ordered, That cattle may be shipped from Massachusetts for pasturage in New Hampshire in cases where the Chief of the Bureau of Animal Industry finds, upon investigation, that it may be done with safety and issues permit therefor, and when the consent of the proper authorities of the State of New Hampshire has been obtained.

B. A. I. Orders Nos. 103 and 110 are modified in accordance herewith.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 114.)

Regulations to Prevent the Spread of Scabies (Mange) in Cattle.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., June 18, 1903.

To managers and agents of railroads and transportation companies of the United States, stockmen, and others:

In furtherance of the regulations for the suppression and extirpation of contagious and infectious diseases among domestic animals in the United States, dated March 10, 1903 (B. A. I. Order No. 106), notice is hereby given that a contagious disease known as scabies, or mange, exists among cattle in

that part of the United States lying west of the Mississippi River and the eastern boundary of Minnesota, and in order to prevent the dissemination of said disease and to aid in its eradication the movement of cattle within and from the above-described section of country shall be governed by the following regulations:

1. Cattle that are affected with said disease or that have been exposed to its contagion shall not be moved or be allowed to move from one State or Territory into another, except as hereinafter provided.

2. Cattle affected with scabies or exposed to the contagion thereof may be shipped for immediate slaughter when transported in cars bearing a placard on each side with the words "Scabby cattle" in plainly visible letters, said placard to be affixed by the railroad company, or they may be transported by boat when healthy cattle are not carried on the same trip. Said cattle when unloaded en route or at destination shall not be brought into contact with healthy cattle. At whatever point such cattle are unloaded they shall be yarded in pens reserved for the exclusive use of such cattle and entirely separated from other cattle pens, or else the pens shall be immediately cleaned and disinfected after the cattle are removed therefrom. The cars or boat spaces occupied by such cattle shall be cleaned and disinfected as soon as possible after the cattle are unloaded and before being again used for cattle.

3. When any cattle affected with or exposed to scabies are found in any stock yards they shall be kept separate from healthy cattle, and shall not be permitted to leave the yards except for slaughter unless they are first dipped in accordance with these regulations.

4. Cattle in the above-described section of country that are not affected with scabies and have not been exposed to its contagion may be moved without restriction, except as may be provided by other regulations of this Department or such as may be lawfully imposed by the authorities of the State or Territory to which destined. Cattle affected with scabies or exposed to its contagion may not be shipped or trailed out of any State or Territory or stock yards for grazing or stocking until they have been dipped in some preparation approved by this Department. Until otherwise directed the lime-and-sulphur dip, made in the proportion of 21 pounds of flowers of sulphur and 16⅔ pounds of unslaked lime to 100 gallons of water and properly prepared, shall be used for dipping cattle. Affected cattle shall be given two dippings, with an interval of 10 to 12 days between; exposed cattle shall receive one dipping.

5. Inspectors of the Bureau of Animal Industry will, upon request, give certificates for cattle found upon inspection to be free from the disease and not to have been exposed to contagion, and for cattle that have been satisfactorily dipped under their supervision.

6. Cleaning and disinfection shall be done by first removing all litter and manure and then saturating the interior surfaces of the cars and the woodwork, flooring, and ground of the chutes, alleys, and pens with a 5 per cent solution of crude carbolic acid in water, with sufficient lime to show where it has been applied.

7. Violation of this order is punishable by a fine of not less than one hundred dollars nor more than one thousand dollars, or by imprisonment not exceeding one year, or by both fine and imprisonment.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 115.)

Modification of Quarantine upon Ruminants and Swine in the States of Massachusetts and New Hampshire.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., June 27, 1903.

It is hereby ordered, That cattle, sheep, and other ruminants, and swine may be shipped from States not in quarantine across the States of Massachusetts and New Hampshire for slaughter or other purposes, without sealing the cars, subject to the regulations of the State to which they are being transported: *Provided,* That said animals shall not be unloaded while in course of transportation across either of said States and shall not be confined in cars beyond the limit of time allowed by law.

It is further ordered, That cattle, sheep, and other ruminants, and swine may be removed or shipped from either of said States subject to the regulations of the State to which destined, after having been inspected by an inspector of the Bureau of Animal Industry, and upon written permit issued by him, stating that the animals are not affected with and have not been exposed to the contagion of foot-and-mouth disease. The hides, skins, hair, wool, horns, or hoofs of ruminants and swine may be removed from said States in accordance with directions that may be issued by the Chief of the Bureau of Animal Industry.

B. A. I. Orders Nos. 103 and 110 are modified in accordance herewith.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 116.)

Special Order Opening Port of Boston to Exportation of Animals.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 20, 1903.

It is ordered, That that the order of November 27, 1902 (B. A. I. Order No. 100), prohibiting the exportation of cattle, sheep, and other ruminants, and swine from the port of Boston, on account of the existence of foot-and-mouth disease in the State of Massachusetts, be, and the same is hereby, revoked, and said animals may be allowed exportation from said port from and after this date.

Any other prior order or part of order inconsistent with this is modified in accordance herewith.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 117.)

Special Order Providing for the Importation of Canadian Cattle, Sheep, and Swine for Exhibition Purposes at International Live-Stock Exposition, Chicago, Ill.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 30, 1903.

It is hereby ordered, That Canadian cattle may be imported into the United States for exhibition purposes at the International Live-Stock Exposition, to be held from November 28 to December 5, 1903, at Chicago, Ill., without being subjected to the tuberculin test, provided they are accompanied by a certificate issued by a Canadian official veterinarian stating that such cattle are free from contagious and infectious diseases: *And provided further,* That the cattle which are not sold to remain in the United States shall be returned immediately to Canada at the close of the exposition.

This Department must be notified of any Canadian cattle that will remain in the United States, and the tuberculin test will be applied to them by an inspector of this Department before shipment to destination is allowed.

All Canadian cattle, sheep, and swine intended for this exposition must be shipped directly to the exposition grounds and not unloaded in any public stock yards.

WILLIS L. MOORE, *Acting Secretary.*

(B. A. I. ORDER NO. 118.)

Removal of Quarantine upon Ruminants and Swine in the State of Vermont.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., September 11, 1903.

It is hereby ordered, That the restrictions placed upon cattle, sheep, and other ruminants, and swine, in certain townships in the State of Vermont, by the order of May 1, 1903 (B. A. I. Order No. 112), on account of the previous existence of foot-and-mouth disease, be removed, and that said animals or their products shall be permitted to be shipped or otherwise removed from said State without restrictions other than may be imposed by the authorities of the State to which said animals or products may be destined.

J. H. BRIGHAM, *Acting Secretary.*

(B. A. I. ORDER NO. 119.)

Removal of Quarantine on Ruminants and Swine in the States of Massachusetts and New Hamsphire.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY.
Washington, D. C., October 14, 1903.

Whereas, All animals affected with foot-and-mouth disease in the States of Massachusetts and New Hampshire have been destroyed, and the premises occupied by them have been thoroughly disinfected, and the contagion of this disease has been eradicated:

It is hereby ordered, That the quarantine upon cattle, sheep, and other ruminants and swine, imposed on account of the existence of foot-and-mouth disease, be removed, and the orders of this

Department relating to such quarantine are hereby revoked. The above-named animals or their products may, therefore, be shipped or be otherwise moved from said States without restrictions other than may be imposed by the authorities of the States to which such animals or products are destined.

JAMES WILSON, *Secretary.*

(B. A. I. ORDER NO. 120.)

Regulations Concerning Dipping of Cattle for Ticks.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 23, 1903.

It is hereby ordered, That cattle originating in the district quarantined on account of the existence of the disease known as splenetic, Southern, or Texas fever of cattle, as defined by regulations of this Department, may, after having been properly dipped in Beaumont crude petroleum, under the supervision of an inspector of this Department, be shipped without further restriction, excepting such as may be enforced by local authorities at point of destination:

Provided, That application be first made to this Department, and permission granted to establish dipping stations, and that after being dipped the cattle are examined and certified by an inspector of the Bureau of Animal Industry; and further

Provided, That the cattle when dipped be shipped in clean cars and not driven through the infected district or unloaded therein, except at such point as may be duly designated in regulations of this Department.

JAMES WILSON, *Secretary.*

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